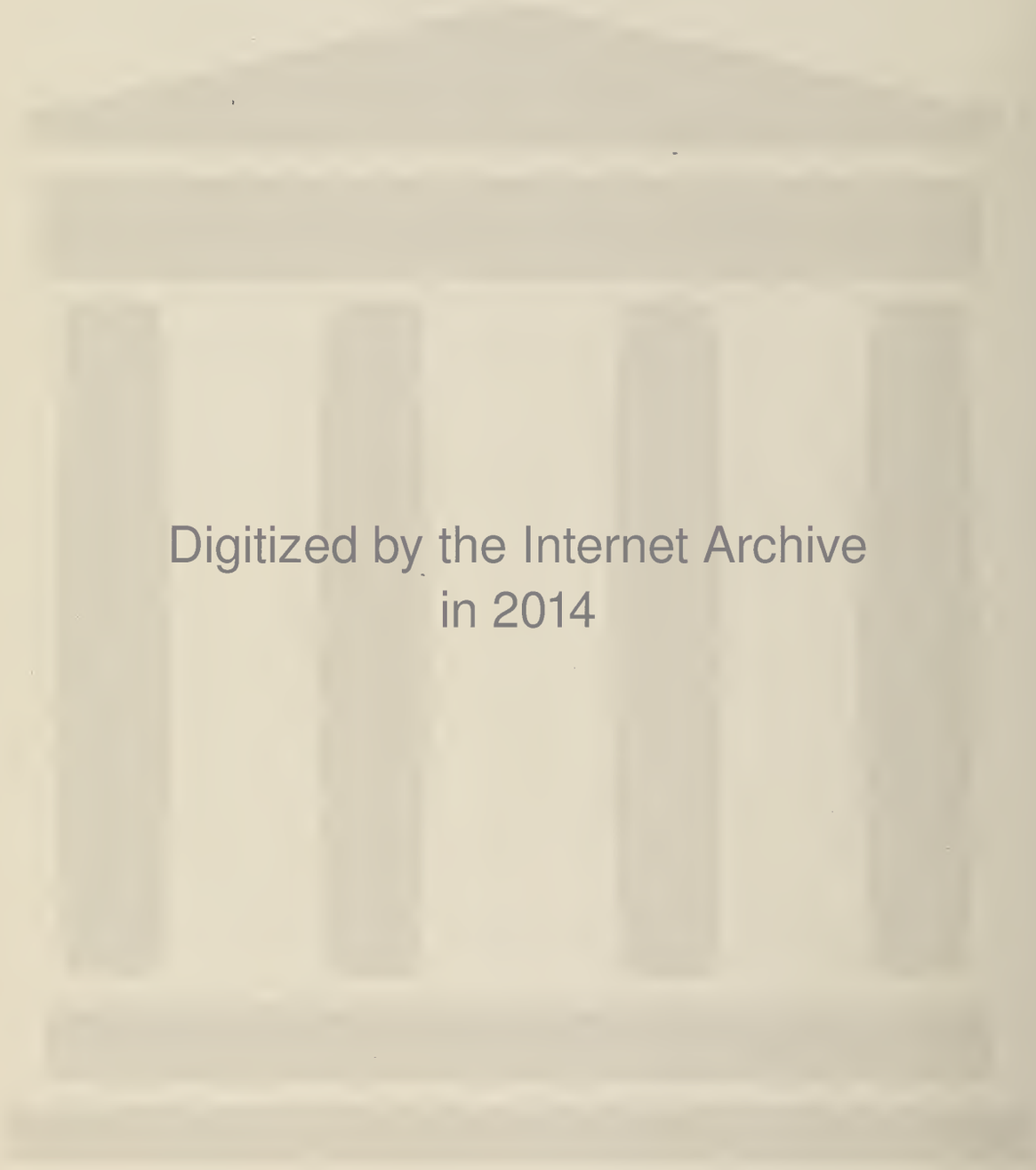


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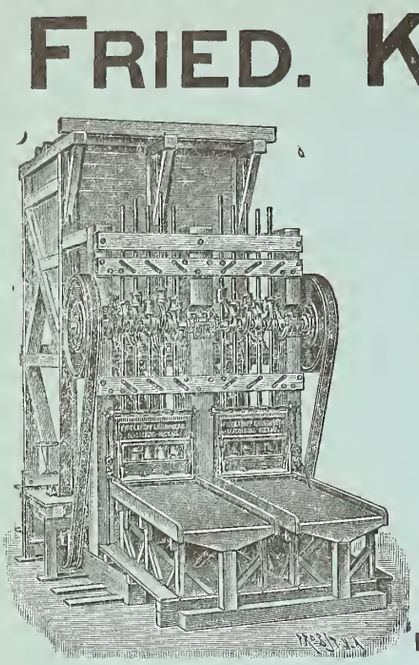
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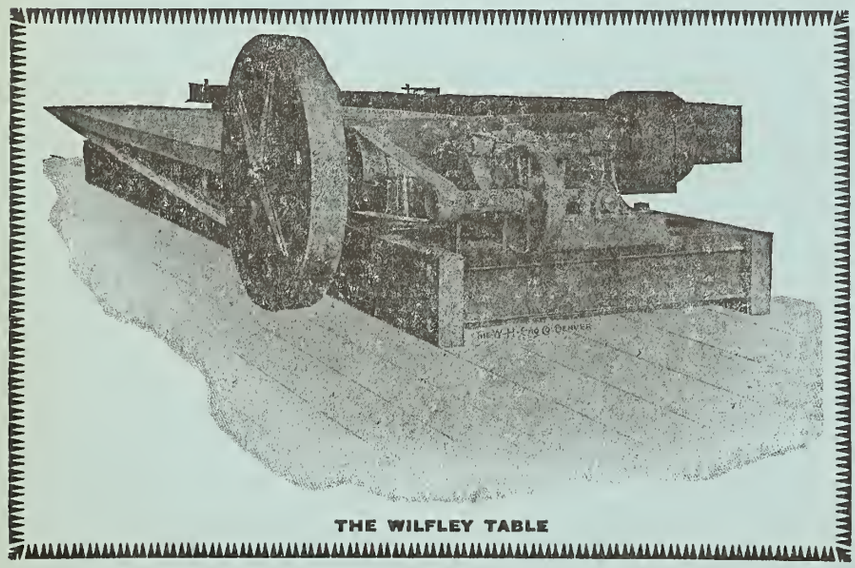
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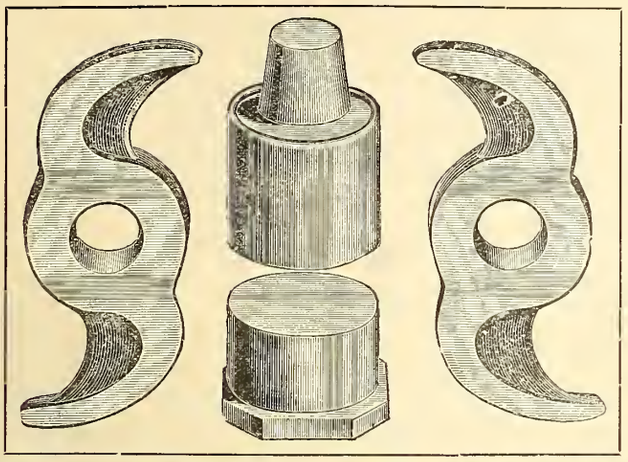
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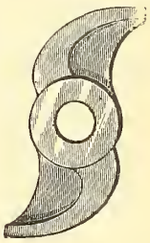
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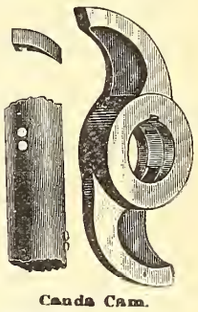


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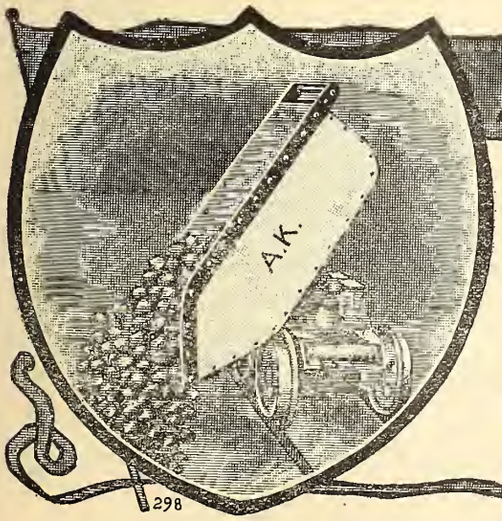
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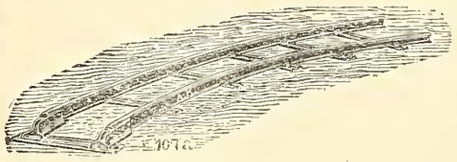
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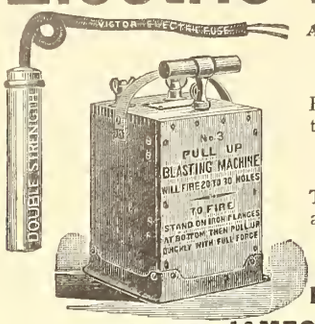


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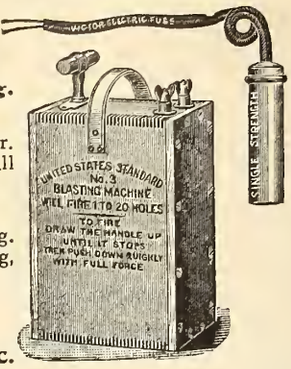
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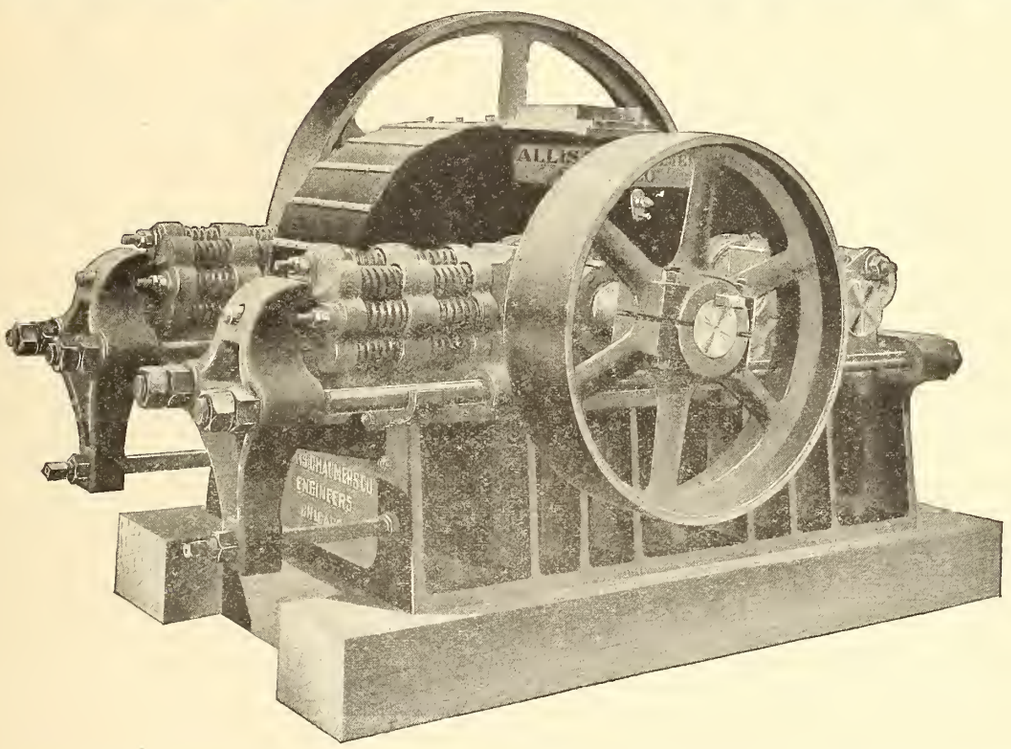
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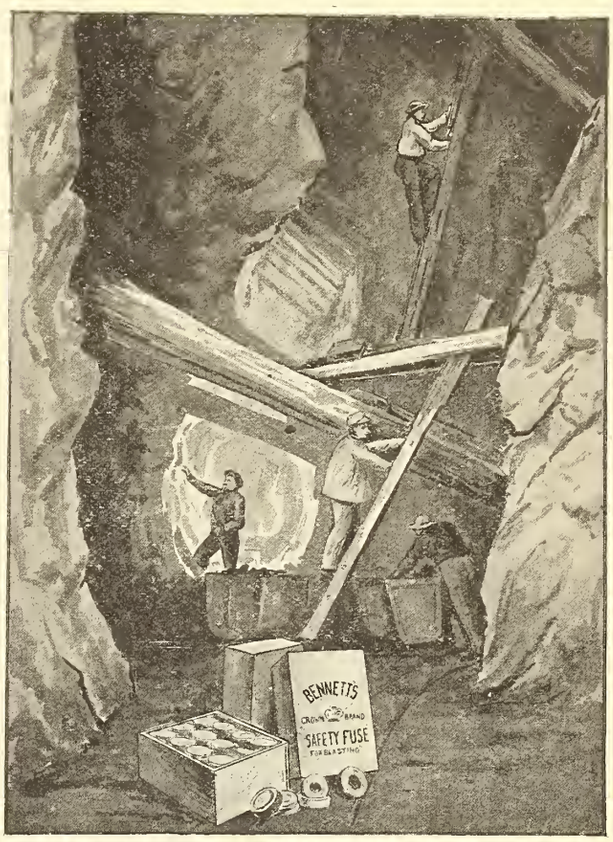
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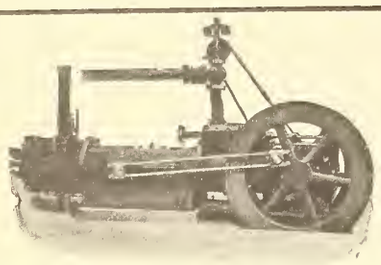
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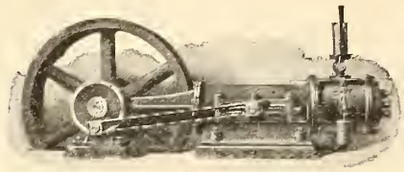
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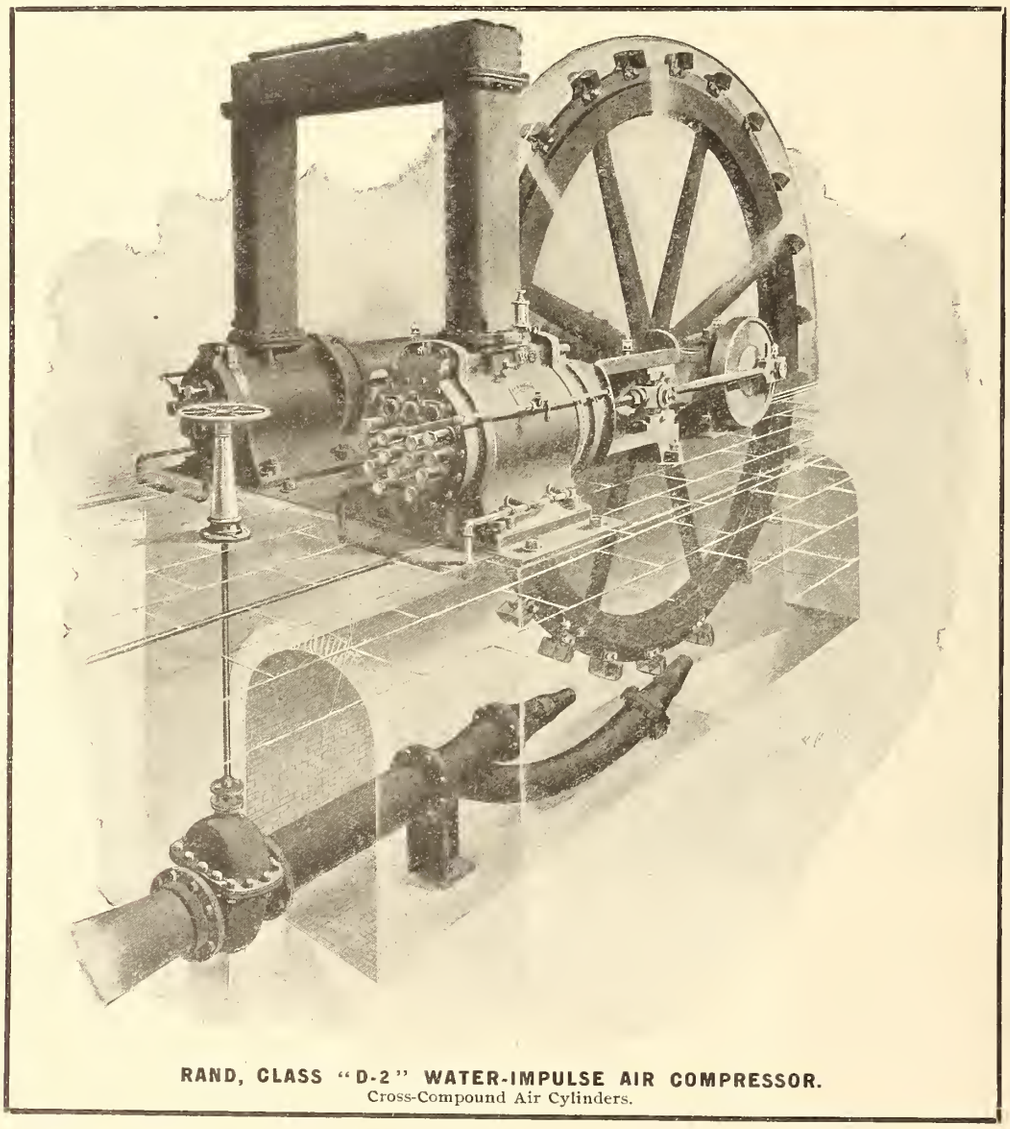
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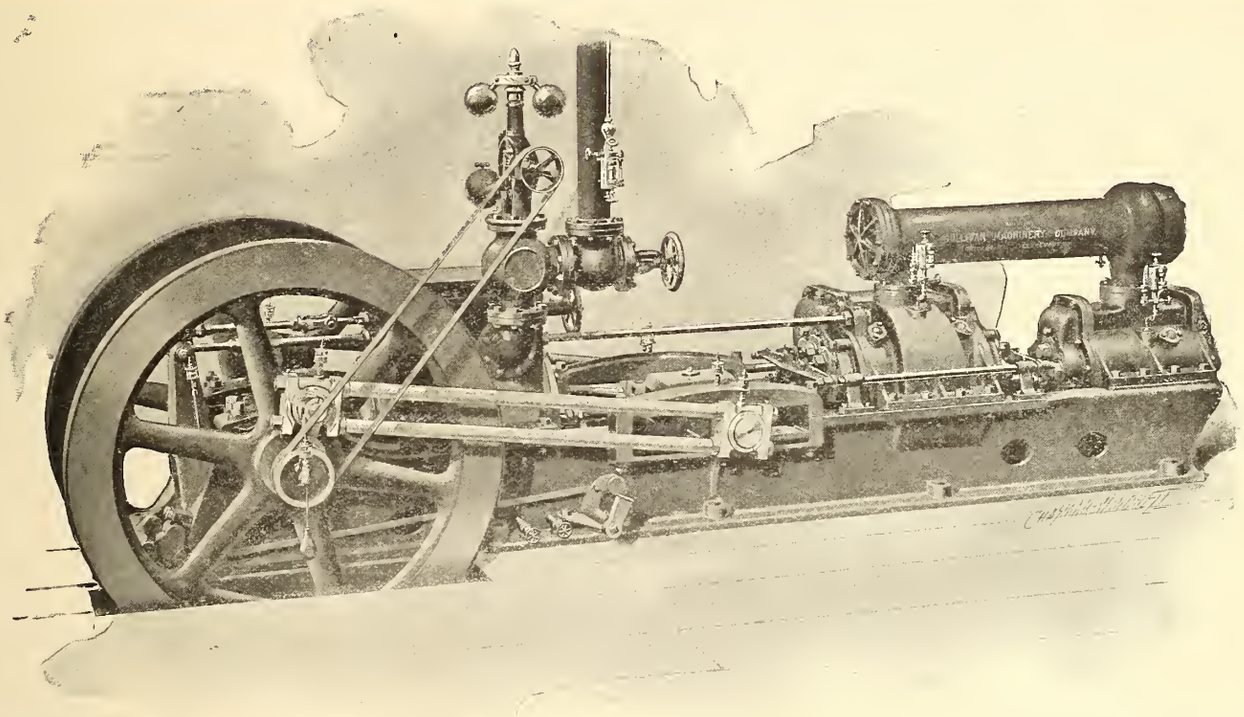
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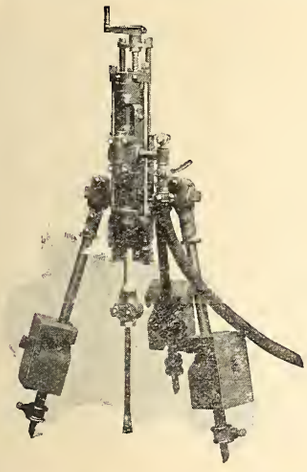
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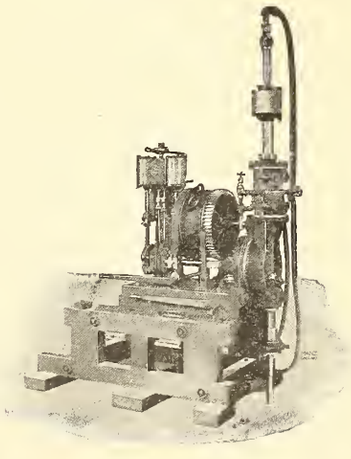


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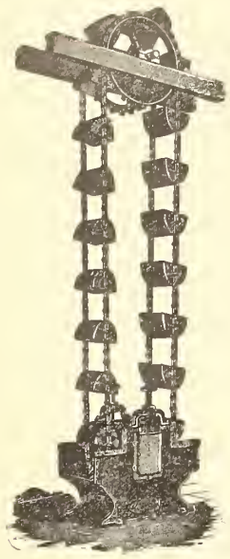
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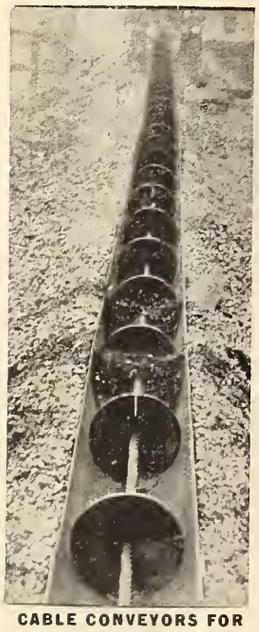


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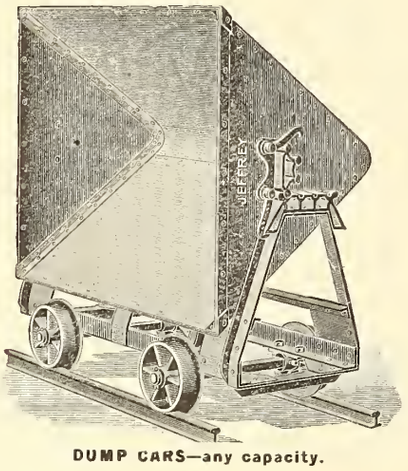


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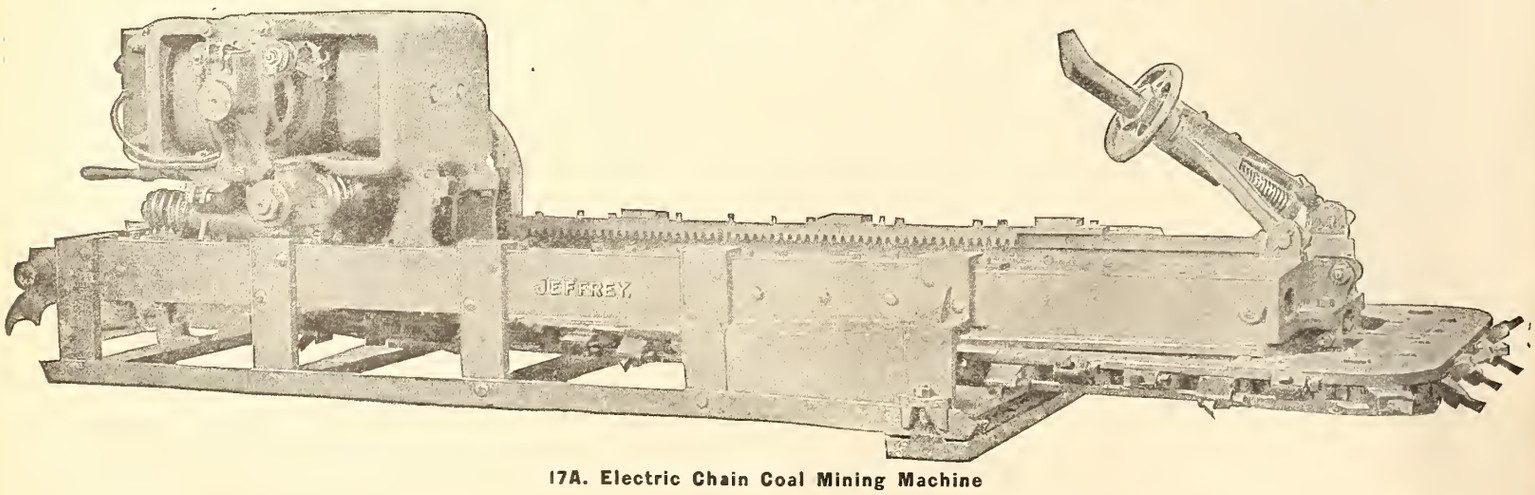


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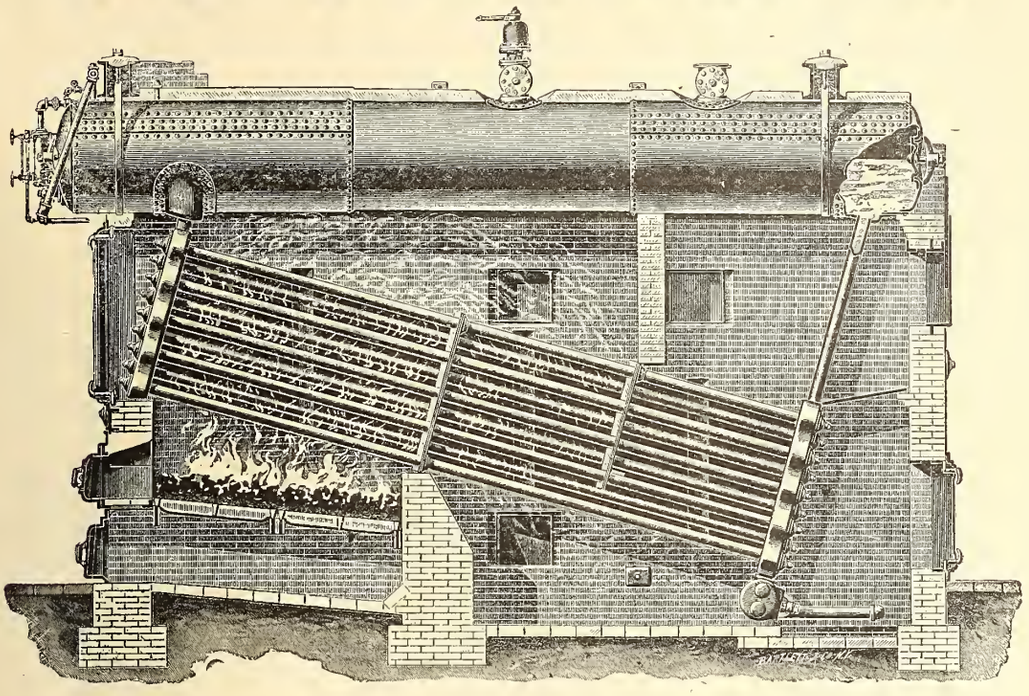
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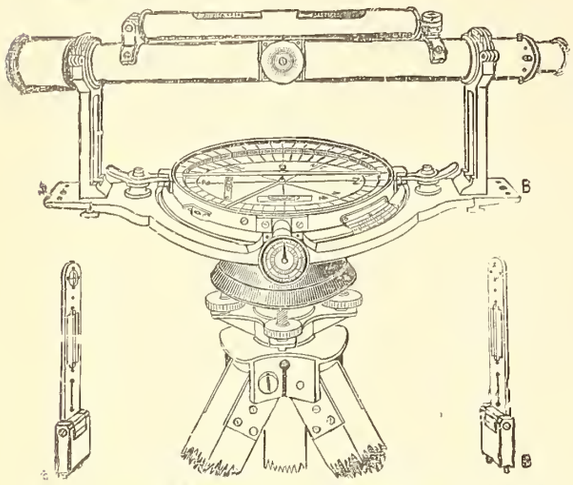
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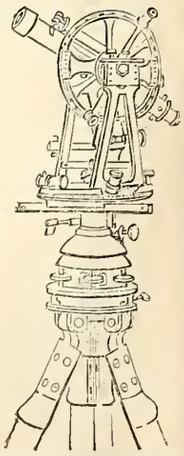
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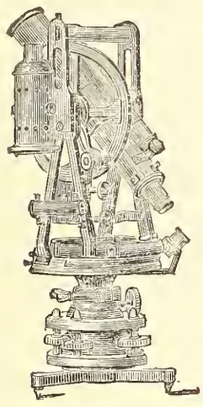
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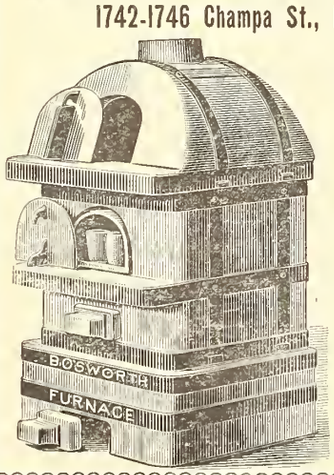
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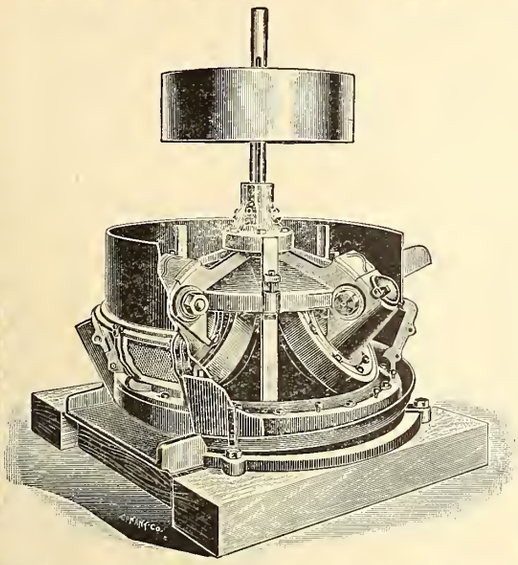
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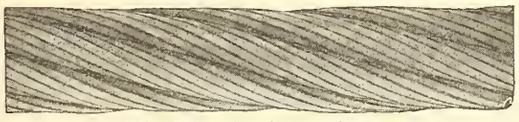
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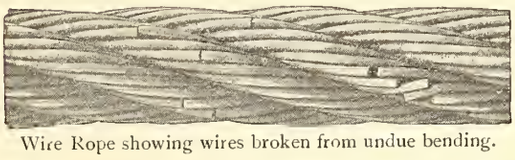
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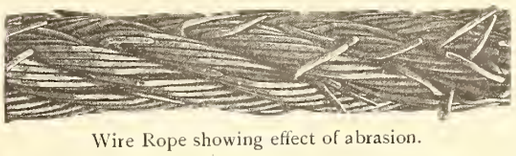
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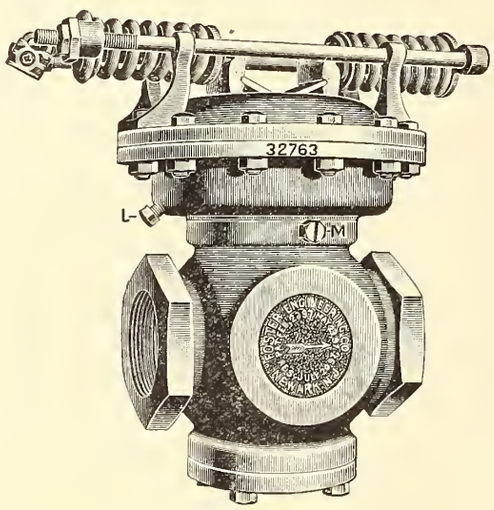
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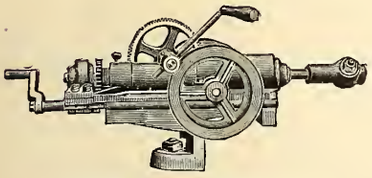
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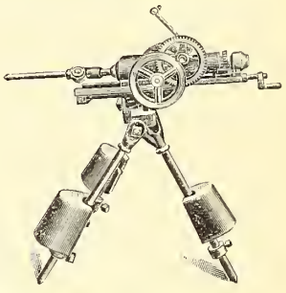
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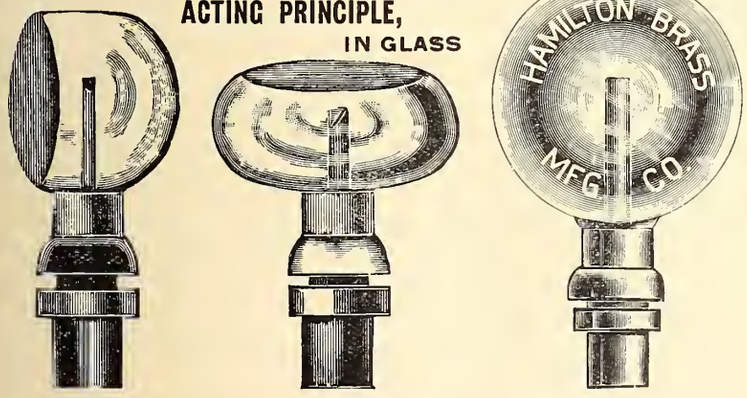
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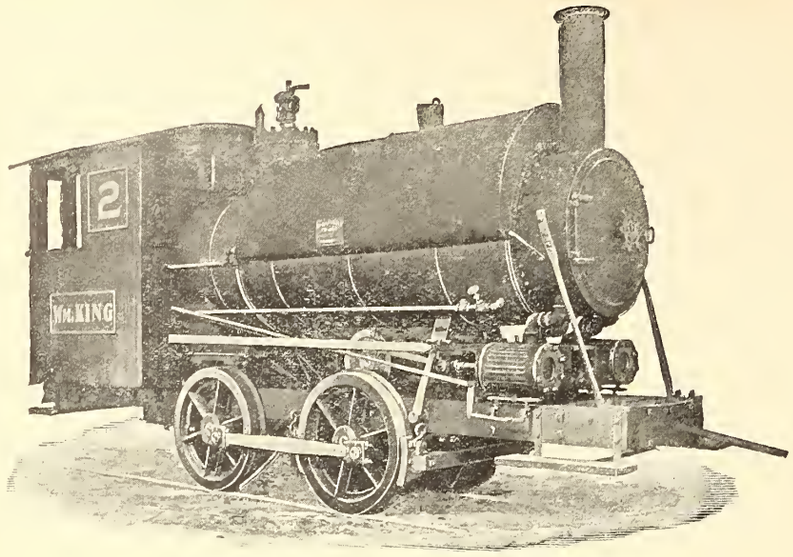
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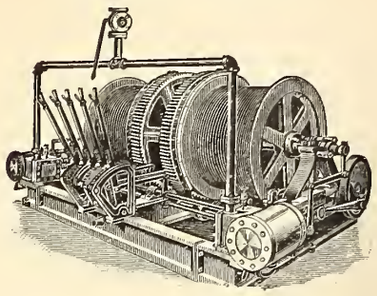
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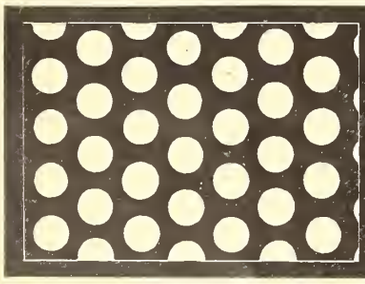
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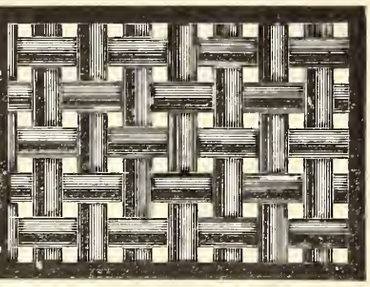


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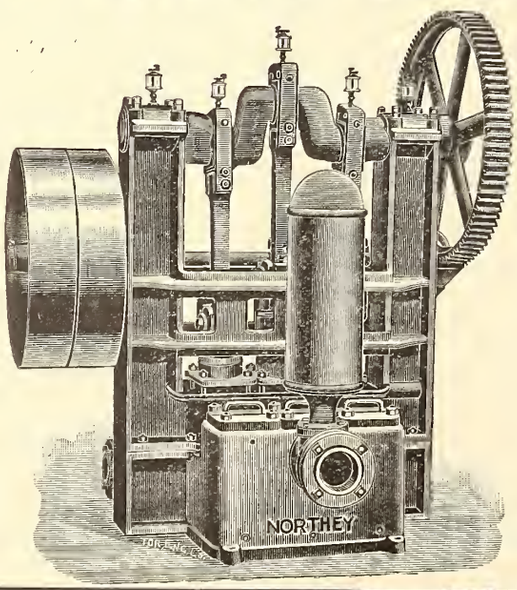
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VOL. XXI., No. 1. JANUARY, 1902. VOL. XXI., No. 1.

The Le Roi Mining Company.

On another page we reproduce in full the report on the property and the late management of the Le Roi Mining Company, Limited, which has been made by Mr. R. J. Frecheville, M. I. C. E., the managing director of the Company, to his Board. This report is of special and peculiar interest, both on account of the conditions under which Mr. Frecheville was invited to become Managing Director, and also, by reason of the very high and unblemished character of the gentleman who has made it.

This gentleman, as our readers may know, was, for a time, H. M. Inspector of Mines for Cornwall and Devon. He is a professional mining engineer of about fifty years of age, and is thoroughly well posted in his profession. The circumstances which led to the making of this report are but too well known to our constituency, and further allusion to the Whitaker Wright combination, and their methods and management is not necessary. Mr. Frecheville came out to Rossland on the 30th of September last, and spent over two months on the property of the Company, during which time the managers of both the mining and smelting departments were discharged and new managers installed. He was assisted in his investigation by a chartered accountant of the well known firm of Price, Waterhouse & Company, and the report referred to contains their summary of an exhaustive examination of the books of both mine and smelter for a period covering more than 28 months, which is practically the whole of the active life of the company under the old regime.

It is a source of special gratification to the REVIEW to present this document in its entirety, and for the reason that it corroborates the views which have often been expressed in these columns during the last four or five years, both as to costs and as to ore values; and also because it is an expression of opinion from the highest and most authoritative professional man who has yet been called upon to study the economic conditions attending Rossland properties. Mr. Frecheville considers the deposits to be the result of the mineralization of crushed shear zones through the action of deep seated thermal waters.

The report is severe in its strictures upon the past management of both mine and smelter, and some idea of the financial methods of the old management is obtained when loans by the Bank of Montreal, to the amount of $974,750, were made upon matte, ore and furnace products aggregating a value of $999,107 *only*: and this too, during the period (or a part of it) when the operating profits were $568,722: all of which sum was expended on capital account.

The statement of working costs given by Messrs. Price, Waterhouse & Co. we commend to the attention of those Toronto gentlemen who may be interested in Rossland. The mining cost per ton is given as $4.146, transportation $0.51, smelting $4.834, matte, freight and treatment $1.234; making the total cost per ton marketed $10.72. Referring to this, Mr. Frecheville expresses the opinion that considerable reductions can be made in the cost of smelting, and lesser reductions in the cost of mining. The REVIEW has printed numerous articles bearing upon costs in the Rossland District, and, in the issue of December 1900, we estimated the actual future total cost per ton as not far from $9.22: Mr. Frecheville puts it at $9.00. We publish these figures to show our readers that the opinions and figures which the REVIEW gives on such matters, from time to time, are obtained from those whose knowledge of existing conditions enables them to compute as correctly as the distinguished engineer above mentioned.

In criticism of the report there are only two points of which we may make mention: the first of these is that since the date of the report (Dec. 4th 1901) the price of copper has fallen tremendously, so that copper, which was then figured at 16½c. is now selling (Jan. 4th) at 12c; the London price dropped from £63 to £47 stg. per ton. We have neither the inclination nor the intention to discuss the copper situation further at this time but it is the concensus of opinion among copper producers that it may be a long time before the price of 16½c. is again realized. This difference of 4½c. a pound would, on the last year's production of this Company (as given in the accounts), have decreased the profit margin by $1.22 per ton, or something near $234,000. The margin figured by Mr. Frecheville, with copper at 16½c. is $2.75 per ton; the present price of copper reduces this to $1.53 per ton, and the total profit may be only about 55% of his figures, so that a production of 200,000 tons of ore per annum *at present prices* would yield a profit of but £60,000 stg. or 6% upon the capital of the Company. This is the adverse view, but it is quite evident that, for some time to come, copper will not reach 16½c. again, and therefore that the profit will be something less than has been figured on prices which ruled during the latter part of 1901.

The second point to which we may allude is that, of the 604,840 tons which is reported as "in sight" there are 44,800 tons included to which a value is given of only $6.43. Past costs are given at $10.72, which Mr. Frecheville believes will be reduced under the new management to $9.00 per ton; with *costs* at *$9.00* per ton and *values* at *$6.42* it is difficult to see the reason for including this block of ground among "Reserves", since there would be a loss of $2.58 per ton, or a total loss of over $115,000, if this block was extracted.

Messrs. Price, Waterhouse & Co's. estimates of current assets and liabilities (on the 30th of Nov. 1901) show a surplus of $39,991,85. From the figures of costs, and of gross values in sight, there would appear to be at present an asset of *nett* ore values in sight of about

$950,000, making the total *nett* assets on Dec. 1st, 1901 something like $990,000, or in round numbers, £200,000.

From these somewhat depressing figures we get relief as to the future of the mine by the statement that the pay chutes (not yet opened but now being opened) in the lowest workings west of the Combination Shaft give an average assay value of $15.75. The length of this chute is given at a maximum estimate, at 700 feet but its decreased length is well compensated by the greater average value, and the driving of the 1050 ft. and the 1200 ft. levels may show greater lengths for the chute, and possibly yet greater values.

The thorough investigation by the Managing Director of the origin of the strike at Rossland last summer has led him to the conclusion that it "was mainly brought about by the injudicious and arbitrary action" of the late manager of the smelting works. It is gratifying to note that all the positions in the smelting works are now filled by non-union men, and that the entire force necessary at the mine will shortly be composed of entirely non-union men also. No prediction is ventured as to the probable daily tonnage that may be expected as output, but Mr. Frecheville does not hesitate to criticise the useless work that has been done, and the "unnecessary machinery" which has been purchased. He characterizes both the plant and the new Combination Shaft as "out of all proportion to the capacity of the mine." "They are imposing to look at, but the money they have cost would have been better appreciated if it had been distributed in dividends."

We commend a thoughtful perusal of this report to all our readers who are interested in Rossland properties. The lessons of overcapitalization, and of extravagant and loose management, which these columns have pointed out for many years now are emphasized by the publication of this report.

Mr. Frecheville's report which we reproduce in full, is as follows :—

ROSSLAND, B C., 4th December, 1901.

The Directors and Shareholders of the

LE ROI MINING COMPANY, LIMITED.

Gentlemen,—Acting under the instructions given me at the Extraordinary General Meeting of your Company held at the end of last August, I have examined your Mines and Smelting Works, and the manner in which your affairs have been conducted.

On the 2nd November last I found it necessary in your interests to remove Mr. Bernard MacDonald from the position of General Manager, and to undertake the duties of this position myself, pending the arrival of Mr. J. H. Mackenzie, whom I have appointed to manage your business. Mr. Mackenzie arrived here on the 26th November, and since then I have been posting him in the details of the undertaking.

The many complicated matters that required looking into and adjusting, together with the details of management, somewhat retarded my examination, so that I was unable to make a definite statement concerning your property until the 25th November last, when I sent you the following cable:

"Auditors make profit from Mine and Smelting Works for the year ended 30th June $586,000.00. This was used for improvements; all the plant first class. I estimate reserves of ore at date above the 900-ft. level 484,000 tons of 2,000 pounds, value per ton, $11.75. The total cost per ton in the future ought not to exceed $9.00. The lowest level in the mine so far as driven shows chute of ore 170 ft. in length, 24 ft. in width, assays average $15.75 per ton. Shaft is down 1,050 ft.; will start driving levels as early as possible. Inventory 23rd November, Smelting Works shows ore, matte on hand and in transit, supplies, $1,045,000.00, at the mine low grade ore dump $100,000.00 net."

NOTE.—Since the date of this cable Messrs. Price, Waterhouse & Co. have made further adjustments, resulting in the profit for the year ended 30th June, 1901, being reduced te $568,722.06.

The data on which the above cable was based are given in the following report, which is accompanied by—

(*a*) Plan of the Le Roi Mine and adjacent properties.
(*b*) Vertical projection of the workings of the Le Roi Mi
(*c*) A complete set of assay plans.

ACCOUNTS FROM 15TH FEBRUARY, 1899, TO 30TH JUNE, 1901.

Messrs. Price, Waterhouse & Co., who have exhaustively examined the books at both Mine and Smelter, have to-day handed me the following statements in advance of their official report :—

ROSSLAND, B.C., December 4th, 1901.

R. J. FRECHEVILLE, ESQ.,
Managing Director, Le Roi Mining Company, Limited.

Dear Sir,—In accordance with your instructions, we have examined the books of the Le Roi Mining Company, Limited, and of the Northport Smelting and Refining Company, Limited, at Rossland, B.C., for the period from the 15th February, 1899, to the 30th June, 1901, and after making certain adjustments of the book figures, we find the profits to have been as follows :—

15th February, 1899, to 30th June, 1900..	$527,562.92
1st July, 1900, to 30th June, 1901..... ..	568,722.06
	$1,096,284.98

We find these profits to be represented on the Rossland books at the 30th June, 1901, by a surplus of assets over liabilities made up as follows :—

Plant, Buildings and Equipment—		
Mine Machinery and Plant	$188,378.48	
Surface Improvements at mine....	89,026.51	
Mine Equipment.....	45,558.70	
	$322,963 69	
Smelter Plant.....	130,986.32	
Flora Lime Quarry.....	7,544.55	$461,494.56
Mine Exploration and Development		153,048.69
James Breen's interest in Northport Smelter..		300,000.00
La Fleur Comstock, &c., Property		50,000.00
Stock of Ore at Mine and Smeiter and Smelter		
Product on hand and in transit.....	731,933.27	
Less—		
Loans by Bank of Montreal secured on same..	616,290.59	115,642.68
Stores on hand at Northport Smelter.....		57,367.53
Debtors—		
Le Roi No. 2, Limited, Cash Advances....	76,881.43	
Rossland Great Western Mines, Limited, Cash Advances.....	41,769.25	
Sundries.....	67,169.79	
	$185,820.47	
Less—		
Sundry Creditors for Wages, Taxes, &c.....	133,464.10	52,356.37
Cash in Bank.....		14,933.74
London Office—Cash remittance.....		39,760.05
		$1,244,603.62
Less—		
Ore in Dump at 15th February, 1899, transferred from the London books to the Rossland books		148,318.64
		$1,096,284.98

We propose to explain our adjustments and to refer more particularly to the above figures in our detailed report.

Yours faithfully,

(Signed) PRICE, WATERHOUSE & Co.

ESTIMATED STATEMENT OF CURRENT ASSETS AND LIABILITIES, 30TH NOVEMBER, 1901.

Matte in Transit....	27·000 lots at	$14,000.00.....		$378,000.00
High Grade Matte..	132·689 tons at	14,000.00 p. 30 tons		61,920.00
Low Grade Matte ..	669·545 " "	300.00 per ton.		200,863.50
Calcined Briquettes.	85·000 " "	300.00 "		25,500.00
Sows	14·422 " "	446.86 "		6,444.61
Bottoms and Furnace Receivers, say				10,000.00
Flue Dust.....	1,100 tons at	$28.95 per ton.		31,845.00
Ore Stock at Smelter.	23 766·355 tons at	7.00 "		166,364.50
Ore in Dump at Mine.	34,252 " "	3.45 "		118,169.40
			$999,107.01	
Less Loans by Bank of Montreal secured on same			974,750.12	$24,356.89

FOR KING AND EMPIRE.



MAJOR W. HAMILTON MERRITT, M.E., A.R.S.M.,
Who has gone to South Africa as Second in Command of the Canadian Mounted Rifles.

Stores on Hand—			
At Mine, say		$50,000.00	
At Smelter, say		35,000.00	
General Stores at Smelter	$47,968.83		
Less Amount owing on same	34,109.11		
		13,859.72	
			98,859.72
Debtors:—			
Le Roi No. 2, Limited	$62,047.35		
Rossland Great Western Mines, Limited	17,449.67		
Sundries	16,724.09		
	$96,221.11		
Less Creditors for Wages, &c.	103,792.66		
		$7,571.55	
Cash:—			
At bank, overdraft	$79,104.94		
On hand, Northport Office	3,451.73		
		75,653.21	
			83,224.76
Surplus			$39,991.85

Mining Property.

The ground owned by you on Red Mountain, near Rossland, consists of the Le Roi and Black Bear Mineral Claims, together with the Le Roi Star, Pearl, and Ruby fractions, having altogether an area of 71.44 acres.

The developments are wholly in the Le Roi Claim, which has a length of 1,500 ft. on the strike of the veins by a width of 600 ft. This claim is held under the old mining law which was in force at the time of its location. By this law, that portion of any vein contained within the end lines of a claim can be followed down indefinitely. The Black Bear Claim is held under the present mining law, which permits of a vein being followed only as far as vertical planes passing through its side lines.

Geological Features.

There are in the Le Roi claim the outcroppings of three veins known as the "North" Vein, "Middle or Main" Vein, and "South or Black Bear" Vein. Of these the Middle or Main Vein is the most important, and has been by far the most extensively developed. It strikes 22 deg. south of west and dips north about 70 deg. from the horizontal. The South Vein, on which there are considerable developments, and which has a similar strike and dip, occurs about 250 ft. to the south of the Middle Vein. Of the North Vein, which occurs about 270 ft. north of the Middle Vein, but little is known beyond the outcrop.

The formation of Red Mountain consists of a variety of diorite known as "gabbro." The veins are sheer zone fissures, that is, they are the result of very powerful compression. They have been mineralized by the action of deep-seated thermal waters. In the Le Roi claim they range in width from 6 ft. up to 100 ft. Their filling consists of altered country rock, through which is distributed pyrrhotite and chalcopyrite, with gold varying in quantity from a trace up to over an ounce per ton. The copper contents average about 1.33 per cent., and there is also a small amount of silver.

The veins are intersected by numerous dykes, having a composition very similar to the country rock. These dykes vary in thickness from a few inches to several feet, they interrupt temporarily the continuity of the ore bodies, but do not displace them. The Josie dyke, however, which occurs about 100 ft. east of the boundary line, separating the Le Roi from the Black Bear Claim, appears to be an exception, for no ore-bearing ground has as yet been found to the west of it in the Black Bear claim, although considerable exploratory work has been done at the 600 ft. level with the object of picking up the continuation of the veins to the west of this dyke. The Josie dyke is about 150 ft. thick, and reduces the length of ore-bearing ground in the Le Roi claim to about 1,400 ft.

Mine Workings.

The Mine is opened out by two incline shafts sunk on the Middle Vein, called the Old Shaft and the Combination Shaft. The former, which is down to the 900-ft. level, is situated about 200 ft. west of the Centre Star boundary line, and the latter which has reached the 1,050-ft. level is 360 ft further west on the strike of the vein or nearly in the centre of the developed ore shoots.

The Old Shaft has recently been straightened und partially re-timbered at a cost of $5,500.00, but is not now used and most probably never will be again. This expenditure might well have been saved.

The Combination Shaft is the working shaft of the Mine. It is 27·5 ft. long by 6 ft. wide in the clear of timbers, and is divided into five compartments. At the 1,050-ft. level the station has been cut, but the levels are not yet driven. The 900-ft. level is the deepest level of the Mine. This shaft has cost in round figures about $100,000.00. It is a fine piece of work, but is unnecessarily large.

The ground proved to be ore-bearing extends from the Centre Star boundary line on the east to the Josie Dyke on the west, a distance of between 1,300 and 1,400 ft. (see Plan A).

At the 500-ft. level the combined length of the pay shoots on the Middle Vein is about 745 ft. On the 600, 700 and 800-ft. levels, it is about 900 ft. for each level. The width of the shoots vary from 6 ft. up to 100 ft. On the 900-ft. level, which is only partly opened, the pay shoot has a length of 170 ft. by a width of 24 ft. The general trend of the ore bodies appears to be to the west, thus at the 900-ft. level no pay ore has been opened out east of the Combination Shaft (see Plan B). If the present shoot now being opened out at this level extends uninterruptedly up to the Josie Dyke, its length cannot exceed 700 ft. This shortening of length is so far compensated by considerably greater average assay value.

The western portion of the South Vein has been opened by cross-cut from the Middle Vein at the 500 and 700-ft. levels, showing a shoot of ore about 140 ft. long, with an average width of 18 ft. The ore is of lower grade than that of the Middle Vein.

Ore Production.

The ton used in this Report is the American ton of 2,000 lbs. In stating values, the basis taken is, gold $20.00 per oz., silver 60 cents per oz., and copper 16.5 cents per lb.

About 20 per cent. of waste is sorted out of the ore hoisted from the Mine, so that the shipping ore is of higher grade than the Mine ore.

For the year ended 30th June, 1900, 102,784·04 tons, containing a gross value of $1,441,128.40, that is $14.02 per ton, were shipped over the Great Northern Railway to your Smelting Works at Northport, distant 18 miles from your Mines.

For the year ended 30th June, 1901, there were shipped 202,582 tons of a gross value of $2,665,689.06, that is $13.16 per ton. For the first seven months of this latter year the ore averaged $14.38, and for the last five months $11.80 per ton. It is thus clear that the cream of the reserves was skimmed off during the first seven months.

During July, August and September of the present year no ore was mined on account of the strike. In October 9,734 tons, averaging $11.67 per ton, were shipped, and in November 12,943·95 tons, of an average assay value of $11.57.

Middle Vein—Quantity and Value of Ore Reserves.

In the following estimates 10 cubic ft. of ore in place are reckoned as equal to 1 ton.

As no proper assay records have ever been kept, and as I found all the information given me to be most misleading, I found it necessary, in order to arrive at the quantity and value os the ore reserves, to prepare a complete set of assay plans. Owing to the wide vein and the hard character of the ground, it was not possible to take more than about fifteen samples per day. As nearly 700 samples were taken altogether, the arduous and lengthy nature of this work of sampling the Mine will be apparent.

Between the 300-ft. level and surface the ore-bearing ground is all worked out, with the exception of three small blocks to the east of Old Shaft, containing 21,540 tons, of an average assay value of $10.75.

Between the 300-ft. level and 450-ft. levels there is no pay ore left; where any ground is standing the values are practically *nil*.

Between the 450-ft. and 500-ft. levels there are 57,740 tons, of an average assay value of $9.90.

Between the 500-ft. and 600-ft. levels there are 27,440 tons, of an average assay value of $12.92; where this ore stands the ground is so badly caved that it is questionable whether this ore can be mined.

Between the 600-ft. and 700-ft. levels there are 113,980 tons, of an average value of $10.99.

Between the 700-ft. and 800-ft. levels there are 215,340 tons, of an average value of $10.32.

Between the 800-ft. and 900-ft. levels there are 96,000 tons, of an average value of $11.32.

South Vein.

Between the 500-ft. level and surface there are 28,000 tons, of an average value of $9.31.

Between the 500-ft. and 700-ft. levels there are 44,800 tons, of an average value of $6.42.

FOR KING AND EMPIRE.



CAPT. R. G. EDWARDS LECKIE, M.E.,

Who goes out to South Africa in command of a Squadron of the 2nd Canadian Mounted Rifles.

Summary of Reserves on Both Veins.

The above figures show that there are in sight on both veins 604,840 tons of Mine ore of an average assay value of $10.36.

The Mine ore, after passing through the crusher on the head-gear of the Combination Shaft, falls into receiving bins, and from these is fed automatically on to three steel endless conveying belts, each 100 ft. long, travelling at the rate of 45 ft. per minute before the sorters, who pick out the waste. A daily record is kept of the number of tons of waste trammed to dump. From these records it appears that 20 per cent. of waste is picked out from the ore hoisted. I had all the waste dumps carefully sampled, several bulk samples of about 30 tons each being taken and passed through the sampling mill. These samples showed the waste dumps at the Combination Shaft proceeding from the sorting tables now in use to assay on the average $5.32 per ton; we have then:—

604,840 tons of Mine ore at $10.36 per ton, containing a gross value of	$6,269,713.25
Less 120,968 tons of waste at $5.32, containing a gross value of	643,549.76
483,872 tons shipping ore, containing	$5,626,163.49

that is $11.75 per ton. The metallic coutents per ton of this grade of ore are—Gold 0·35 oz., Silver 0·6 oz., and Copper 1·33 per cent.

Useless Work.

At the 900-ft. level, opposite the Old Shaft, a cross-cut has been driven to the north for a distance of 870 ft., passiug through the Josie claim into the Number One Claim. This cross-sut, which cost $23.75 per foot, was driven for no other purpose than deqeloping the Le Roi No. 2; nevertheless, the whole cost, amounting to $20,662.50, has been paid by you.

Working Costs.

Messrs. Price, Waterhouse & Co. make the total costs on this side for the year ended 30th June, 1901, to be $10.72 per ton of ore, segregated as follows:—

	Per Ton.	
Stoping, hoisting, tramming, sorting and loading ore.	$3·487	
Exploration	·423	
Depreciation—		
Mine Equipment	·080	
Surface Improvements	·050	
Mine Machinery	·106	
		$4.146
Freight on ore to Smelter		.510
Smelter expenses	4·465	
Interest and discount (on ore in yard)	·137	
Depreciation	·232	
		4·834
Matte expense—		
Sacking and Crushing	$·044	
Freight on Matte to Refiners	·536	
Eastern Representative	·028	
Bank Charges	·092	
Refiners' Toll and Deductions	·534	
		1·234
		$10·724

The average gross value of the 202,582 tons of ore shipped to your Smelting Works at Northport during the same year was $13.16 per ton. The above working costs make the net profit on this ore $2.44 per ton, or $494,300.08 on the whole tonnage.

The actual profit based on matte sold cannot be given, as together with your ores were smelted about 26,000 tons of purchased ores and concentrates.

The management has been most loose and extravagant; great reductions cau be made in the costs of both mining and smelting, especially the latter; much useless extraneous expenditure can be cut off, the result being, I am of opinion, that in the future the total costs will not exceed $9.00 per ton. With the grade of ore you now have in reserve this will leave a profit of $2.75 per ton.

Second-Class Ore Dump.

This dump was taken over at the time of the purchase of the mine. During the year ended 30th June, 1901, 10,454·935 tons were sold to the Trail Smelter, where they were used as a flux for lead ores, and realized net $50,556.85; deducting from this amount 25 cents per ton for loading on cars, the balance of $47,943.12 is profit; but of this amount only $12,409.29 should, in the opinion of Messrs. Price, Waterhouse & Co., be credited to the profits of the year under review, the balance being credited to the cost of property account.

Since June 30th last, a further 11,270 tons have been sold, realizing $53,921.89. Just how much of this dump remains it is impossible to say, owing to the irregularities of the ground occupied by it, and the fact that it merges into and is partly covered by a dump of waste, but it may be taken as an asset representing about $100,000.00 net.

Waste Dumps.

There are four of these dumps, containing altogether about 90,000 tons. Half of this tonnage proceeds from the sorting tables at the Combination Shaft, and assays per ton as follows:—Gold, 0·125 oz.; silver, 0·3 oz.; copper, 0·8 per ceut.; that is, a money value of $5.32. The other half is from the previous sorting, when the mine was worked through the Old Shaft, and assays:—Gold, 0·18 oz.; silver, 0·4 oz.; and copper, 1.1 per cent.; that is, $7.47 in money.

These dumps are now being added to at the rate of about 3,000 tons per month, but the value of the waste now sorted out has been reduced to under $5.00 per ton, due to a system that I have introduced of having it sampled and assayed daily. It may be that this waste can in the future be profitably treated, and experiments are now in progress as to the best method of accomplishing this.

Mine Equipment.

At the Combination Shaft there is a fine massive head-gear, 85 ft. high, with first-class crushing, conveying, sorting and sampling machinery, all dtiven by electric power. There is also an automatically working aerial tramline leading to the ore bins on the Great Northern Railway.

There are two double-cylinder uiodern type winding engines, one of 1,000 nominal horse power, and the other of 500 nominal horse power. The larger eagine is used exclusively for hoisting ore, skips of four tons capacity being used. The smaller engine is used for the purpose of raising and lowering men, tools, timber, &c.

The boiler and compressor plant, together with fitting shop, timber framing shed, blacksmith's shop, store, &c., are situated on the Black Bear Claim about 800 ft. distant from the shaft. There are eleven boilers of a capacity of 2,000 nominal horse power, and two large cross compound air compressors, each capable of running forty 3¼-in. drills at sea-level.

The plant is substantially erected and first-class in every respect, but both it and the Combination Shaft are out of all proportion to the capacity of the Mine, as they could easily handle 2,000 tons of ore per day. They are imposing to look at, but the extra money they have cost would have been better appreciated if it had been distributed in dividends.

Unnecessary Machinery.

At the Combination Shaft there is a fine Corliss engine, mounted but not in use, and an electric generator unmounted. I was told by the late manager that they had been purchased to hold as a club over the head of the West Kootenay Power and Light Company, so as to prevent this Company from increasing its rate for power and light. The cost of this machinery landed here was $5,300.94. It will never be required.

The Mine is drained of water by means of pumps driven by compressed air. These pumps work about eight hours per day only, the water being very light; nevertheless, there arrived here about a month ago two magnificent electric pumps with the motors for driving them, their cost landed here is $7,278.52. This machinery was certainly not wanted, and what makes the matter worse is, that the dimensions of the pumps and fly-wheels do not admit of their being let down the shaft. If ever used, they will have to be cut up into sections.

Two skips were purchased for the Old Shaft; they cost $1,619.25, and will never be used on your Mine.

Two cages were purchased for the Combination Shaft at a cost of $1,580.79, but their dimensions are unsuitable for the track.

Evidently the appetite for purchasing machinery grows with feeding.

The Northport Smelting Works.

These works are owned by the Northport Smelting and Refining Company, Limited, an American organization, with a nominal capital of $1,000,000, divided into shares of $1 each. The shares are all owned by your Company.

The works are situated at the town of Northport on the Columbia River, in the State of Washington, and are connected with your mines by a branch of the Great Northern Railway.

They consist of five large water-jacket copper-matting furnaces, with

another on the ground ready to erect, two large automatic single-hearth calcining furnaces, and one large double-decked calcining furnace, pug-mills, briquetting machines, &c. The full capacity of the plant when No. 6 furnace is erected will be from 1,200 to 1,5co tons of ore per day.

There is in course of erectian an endless chain haulage system to deliver the ores from the receiving bins to the roast heaps, and an electric railway to take the ore from the roast yard to the bins at the back of the furnaces. The trucks will be loaded at the roast heaps by means of a steam-shovel now on the ground. These new additions to the plant will, if they operate successfully, save a considerable amount of manual labour.

From the books it appears—

That durirg the year ended 30th June, 1901, 234,35·87 tons of ore were received at these works, of which 31,771·87 tons were purchased.

That there were smelted 191,144·17 tons, having a gross value of $2,678,909.39, or $14.02 per ton (of this ore about 26,oco tons were purchased).

That the ore smelted produced 5,817.14 tons of matte, assaying gold 16·27 ozs., and silver 30·63 ozs. per ton, with 45·63 per cent. copper, making the gross value of the matte $2,875,980.17. This shows an extraction of 7·35 per cent. above the metallic contents of the ore, thus making it clear that either the sampling was at fault, the assays too low, or something of both.

That the 5,817·4 tons of matte, less freight and refiner's toll and deductions, realized $2,656,725.71.

From these records it is an impossibility to arrive at any exact figures as to the profits made from smelting purchased ores ; an approximation only can be made by deducting the estimated profit on your ores, and the second-class dump ore sent to the Trail Smelter from the total amount of profit.

Thus I have shown the profit on the ore mined during the year to have been $494,3co.08, and the profit on the secord-class dump ore sent to Trail Smelter to have been $12,400.29. Deducting these two amounts from $568,722.06, which is the total amount of profit, leaves $62,021.69 as the profit made on the 26,000 tons of purchased ore smelted.

The metallurgical work has been very bad. By using a strong blast and a very high percentage of coke the ore has been smelted, but at how much extra cost and at how great a loss in flue dust will never be known. Amongst the purchased ores smelted were 923·8 tons of concentrates from the Baker City Sampling Works assaying 3.27 oz. of gold per ton. These were often charged into the furnaces raw without briquetting, the result being that a large percentage of this valuable material has been carried by the strong blast through the condensing chambers, up the stack, and scattered over the surrounding country. It appears, as Mr. Bela' Kadish, the late Manager of the Smelter, is the owner of the Baker City Sampling Works, and was thus in the position of buyer and seller at the same time, that the more concentrates were used the better it was for business.

The new Manager, Mr. Oscar Szontagh, has already made many great improvements. He purchases no more concentrates, as he is able without using them to make matte of the grade in gold required by your contract with the American Smelting and Refining Company. He has completely done away with the granulation and calcination of the low grade matte ; this will very largely reduce the smelting cost, and to a great extent obviate the mechanical loss in handling and the loss in flue dust. The double-decked calcining furnace recently erected by Mr. Kadish at a cost, including building to cover it, of $27,354.86, will never be used on your ores. The consumption of coke has also been reduced, and with all this there has been no reduction in the quantity of ore put through the furnaces, as with four running, over 800 tons of ore per day are now being smelted.

The coke used costs $10.00 per ton delivered at the works. When the Great Northern Railway Company have completed their branch line now being built into the Crow's Nest Coal Fields, it is probable that you will be able to get coke at about $8.00 per ton. As about 200 tons per day are used this means a notable saving.

NOTE.—Mr. Miller, the Vice-President of the Great Northern line, informs me that this branch will be ready for traffic by next April.

THE STRIKE SITUATION.

I have carefully gone into this matter, interviewing all sorts and conditions of men, and am of opinion that the strike was mainly brought about by the injudicious and arbitrary action of Mr. Bela' Kadish, the late manager of your Smelting Works at Northport, where the strike first commenced. The strike at Rossland is a sympathetic one ordered by the Western Federation of Miners, which has its headquarters at Denver, Colorado, the Rossland Miners' Union being a branch of that organization.

The demand for an increase of 50 cents per day in the "muckers" wages is simply a pretext. More "muckers" than are wanted can be got for $2.50 per day, which now is and always has been the rate of pay for this class of labour at Rossland. The miners who receive $3.50 per day have no grievances that I am aware of.

As a matter of fact the strike was, according to the by-laws of the Union itself, illegally called.

The battle having once begun has to be fought out, if you wish to have control over the working of your property.

Any concession, no matter how slight, to the demands of the Union would be hailed as a victory, and would be followed by still further demands.

The rank and file of the Rossland Miners' Union would now gladly call off the strike, but they are powerless to do so, being under the control of professional agitators, who in their turn are ruled by the orders of the orders of the Western Federation of Miners at Denver.

As it is, your mine and smelting works are being filled up with non-union men ; the smelting works have already got their full complement, and it will not be long before your mine will be in the same position.

Naturally, at first many of the men were green hands, and work was carried on at a great disadvantage, but this condition of affairs is improving daily, incompetent men are being weeded out and replaced by skilled miners.

For the month of October, when work in the mine was restarted, the output was 9,737 tons, whilst for November it was 14,088 tons.

I predict that, under the new management, your mine will soon be working up to its full capacity, and be at the same time vigorously developed.

CONCLUSION.

After the exhaustion of the existing ore reserves, the future of the mine will mainly depend on the results to be obtained by development work to the deep on the Middle Vein. In this connection it is encouraging to note that the pay shoot now being opened out on the Ninth Level west of Combination Shaft has an average assay value of $15.75. No time will be lost in opening out the 1,050-ft. level, and sinking the shaft for the next level, which will be at 1,200 ft.

My investigation shows that there has been very great extravagance and looseness of management, resulting in unwarranted expenditure and high working costs, also that under proper control your property would have paid dividends from the start.

I leave here for London on the 7th instant, in the full conviction that I have placed your affairs in the hands of a thoroughly capable and conscientious Manager, whose sole object will be to conduct the operations at both Mine and Smelter for the best interests of the Shareholders.

I am, Gentlemen,

Yours faithfully,

(Signed) R. J. FRECHEVILLE.

Mining Progress in Nova Scotia During the Year 1901.

Outside of the progress made in coal mining, the direct advance made by Nova Scotia in developing her mineral resources has not been marked during the past year.

In the coal trade the total sales amounted to 3,395,300 tons against 2,810,485 tons the year before. In Cumberland and Pictou Counties business was very slack during the summer. One reason given was the purchase of United States' coal for the use of the Intercolonial Railway last winter in view of a threatened strike. The sales of the Dominion Coal Company increased from 1,808,694 tons during the twelve months ended Sept. 30th, 1900, to 2,245,000 tons for the year just ended.

The sales to Quebec and Ontario ran a little over one million of tons, and those to the United States were in the vicinity of last year's, about 600,000 tons. A considerable increase took place in the home sales owing to the increasing demands of the Dominion Iron and Steel Company. Sales to other points remain practically unchanged.

In Cumberland County improvements were made at the Springhill Collieries, and at the Joggins. The only point of interest in Pictou County was the opening by the Nova Scotia Steel and Coal Company

of a mine in one of the Marsh seams near New Glasgow, to supply their converters at Trenton.

In the County of Inverness, the Port Hood mine has been put on a producing basis, and will, during 1902, become a competitor in the market. The Broad Cove mine is also being prepared for a large output, and it is reported that the Mabou mine will shortly be opened systematically.

In Cape Breton County the sinking of Dominion No. 2 has been finished and the preliminary opening-out work is well under way. The slope on the Emery seam, Dominion No. 4, was closed, as the seam became too thin for working in comparison with the Phalen. The Gowrie & Blockhouse mines continued driving into their sea areas. The Nova Scotia Steel and Coal Company are engaged in extending their shipping facilities, and in preparing for an enlarged output. The Cape Breton Coal Co. at New Campbellton continued working steadily, and find the quality of their coal improving.

The Government drills were successfully employed during the year. In Cape Breton County the seam at the head of Lingan Basin was traced some distance to the westward, thus adding very materially to the value of the coal field.

The records of the coal sales of Nova Scotia have been kept since the year 1785, and are as follows:—

1785–1830	378,296
1831–1840	839,954
1841–1850	1,533,798
1851–1860	2,399,319
1861–1870	4,927,339
1871–1880	7,317,430
1881–1890	13,910,136
1891–1900	20,552,536

Gold mining has yielded about 32,000 ounces, or about the same as the previous year. This was obtained from about 90,000 tons of quartz and slate.

The list is headed by Stormont district with 5,000 ounces from about 30,000 tons of crushing material. The well-known Richardson mine has continued yielding steadily. The western extension of the ground worked by this company is being developed by the Dolliver Mountain Mining and Milling Co. and it is expected to be a large producer this year. The Waverley returns show 3,000 ounces from 9,000 tons of rock, the production of the Waverley Gold Mining Company.

Discoveries of promising leads are reported from several points and it is hoped that 1902 will show a decidedly increased production. Application was made for a Government drill to bore on the anticlinal at Goldenville, but the parties interested changed their minds The subject of deep mining and of the exploration of underground reefs is one that appears worthy of the consideration of the Government, as it has a most important bearing on the permanent mining development of our gold districts.

The Nova Scotia Steel and Coal Company continued working their Nova Scotia mines, and extracted about 10,000 tons of ore. No other iron ore mining was done in the Province. The explorations at Torbrook, Annapolis County, were concluded in the spring, after showing that the tonnage of the district could be counted by hundreds of million of tons. It is apparently one of the largest iron ore deposits on the continent. The deposits of magnetite at Whycocomagh, Inverness County, were traced still farther to the north.

The Nova Scotia Steel and Coal Company have completed a block of retort ovens at North Sydney, which supply coke to their Ferrona furnace, and will ultimately form part of their steel plant. Their production has been about 26,000 tons of pig iron.

The Dominion Iron and Steel Company have three furnaces running which have produced about 90,000 tons of pig. Their converters are practically completed and they enter on the second state of their large enterprise with the New Year.

In connection with the operations of these two companies about 400,000 tons of Wabana ore have been imported, and about 150,000 tons of coke have been burned. During the year about 80,000 tons of limestone have been quarried by them. As these two companies extend their operations toward their completion, it is realizable how important an addition they will form to our coal and quarry development.

The extraction of gypsum may be estimated at 135,000 tons. Most of this is shipped from Windsor to the United States, on barges towed by powerful tugs.

About 600 tons of barytes were mined at Cape Rouge, Inverness County, intended for consumption at Halifax.

The extraction of tripoli has been continued with a production of about 800 tons. No systematic copper mining has been carried on during the past season. Explorations were continued at Coxheath. In the Mira district Mr. W. N. Young did some work on medium-grade copper ore deposits which are proving to be of large extent. The Munro-Thompson Company report that their mine at Wentworth, Cumberland County, contains an extensive deposit of fair grade ore, and that they are preparing to equip the mine and build a smelter. At Cape d'Or, in the same county, a large expenditure has been made by the Colonial Copper Company, on several large zones in the trap which carry native copper, and they feel confident of an extensive deposit.

Cyanide Practice.

A volume of considerable interest and value to Canadian mining men, and particularly those of them who are interested in gold extraction, has just been published from the pen of Mr. Alfred James, M.E., F.G.S., late technical manager and special expert of the company introducing the cyanide process. In a prefatory note Mr. James points out that his excellently printed and beautifully illustrated volume on "Cyanide Practice" is not intended to furnish a complete history of the cyanide process, or a law report of the various battles of patents to which the process has given rise. Nor does it give details of all equations that have been published regarding the chemistry of the process, or of the more or less successful modifications which have from time to time been propounded or adopted in various parts of the world. The earlier chapters have already been contributed by the author to the proceedings of The Institution of Mining and Metallurgy and The American Institute of Mining Engineers, and are now, with additions and some detail illustrations, brought up to date and assembled into book form. A considerable portion of the contents has, however, been written specially for this volume, and is now published for the first time. It is hoped that the process section will give sufficient information to enable the mining engineer to accurately test his products, design and erect efficient and economical plants, and work them successfully. The practical details concerning the construction of vats and the method of arranging the foundations of double treatment plants should be of some use to the engineer called on to deal with such propositions. The latter portion of the book specializes and shows the advances which have been made in the treatment of dry crushed and roasted ores, and in the treatment of slimes by filter-press and other methods. This section shows the general tendency of the various fields of the world to evolve types of plant peculiar to their own requirements. We commend this serviceable work to all who may be interested in cyaniding. It is published by E. & F. N Spon, London, and may be obtained on this side from the Engineering and Mining Journal Company, New York. Price, $5.00.

Presentation to Mr. J. Geo. Rutherford, M.E.

Mr. J. Geo. Rutherford, who, for the past twenty years, has occupied the important and arduous position of mining engineer and assistant manager of the collieries operated by the Acadia Coal Co., in Pictou County, N.S., has recently severed his long standing connection with that company and has gone to the Joggins colliery of the Canada Coals and Railway Co. at Maccan, where he assumes Mr. Archibald's position of general manager. The position which Mr. Rutherford occupied at the Acadia was one of great responsibility and could only be successfully filled by an engineer of more than ordinary ability; and in the performance of his duties Mr. Rutherford has had many trying, even hazardous, experiences, through all of which, happily, he passed safely and successfully. On such occasions he showed great solicitude for the safety of the men under him. At the explosion in the slopes of the Albion collieries some twelve or thirteen years ago Mr. Rutherford had a very close call. On the morning of the accident he was engaged with a number of workmen in walling off part of the pit when through the leakage of gas, etc., it became almost unbearable for human beings to breathe; and the work being nearly finished, and fearing the worst, he ordered all the men that were not absolutely needed to go above ground and he himself would stay with three other men and finish the work. Just as the car containing the men was leaving the bottom, Mr. Rutherford, seeing the work about finished, thought it better for them all to go together. They did so, and were no sooner at the surface and away from the mouth of the slope when the explosion occurred. This is one of a number of instances in which Mr. Rutherford showed not only presence of mind but solicitude for those working with him at a critical moment.

Before leaving, the citizens and miners entertained Mr. and Mrs. Rutherford at a public meeting in Stellarton and presented them with an address and a handsome service of plate. The address was to the following effect:—

J. Geo. Rutherford, Esq.,

Dear Sir,—We, the members of Buller Lodge, No. 31, P.W.A., together with the other citizens of Stellarton, on the eve of your departure from our midst, desire to bear testimony to your worth in your profession and position, as well as a citizen.

During your service of twenty years with the Acadia Coal Co., Ltd., we have had all times, and under all circumstances the fullest confidence in you as a mining engineer.

We are not ignorant of how much depended on your skill, care and judgment, not only to the company for which you worked, but also to us even to our lives, yet we are pleased to state that we never feared through any want of confidence in you.

We know of the dangerous nature of your work oftimes. During our connection as official and workmen, we recollect many times of extreme danger, at all of which we have admired your bravery, unselfishness and consideration for others.

In your dealings with us we can truthfully state that we can always remember you as a fair, courteous and gentlemanly official whose word was not to give a command to "go" but rather an invitation to "come."

Having, therefore, full confidence in you and entertaining for you as we do feelings of deep gratitude and respect, is it any wonder that we look upon your removal from us with some concern? We would not however, be selfish, but we would rather rejoice that you are to occupy a position of greater trust in which we feel assured you will be equally successful and popular.

The citizens of this town unite with us in giving expression to their sense of loss in your departure from their midst. Your estimable wife and interesting family will be greatly missed. We have the most pleasant recollections of these years of citizenship and our earnest desires are for your prosperity and welfare wherever you may be.

We ask of you to accept this gift as a token of our esteem, hoping that some time in the future it may cause your mind to revert to the workmen and citizens of this town whose best wishes are for the success and usefulness of both yourself and family.



MR. JOHN JOHNSTON,
Appointed Resident Manager of the Sydney Mines Colliery of the Nova Scotia Steel and Coal Co.



MR. J. GEO. RUTHERFORD, B.A., M.E.,
Appointed General Manager to the Canada Coals and Railway Company.



MR. T. J. BROWN,
Appointed General Superintendent of the Nova Scotia Steel and Coal Company.

Anglo-Canadian Lead Syndicate, Limited—The following is excerpted from the Directors' Report under date of 19th December, 1901:—"It will be remembered that the Syndicate's capital is almost entirely invested in the British and Canadian Lead Co. Ltd., whose report and accounts to 30th June last (submitted and passed at the company's annual meeting on the 7th ult.) were issued for information to the shareholders of the Syndicate. The directors need not, therefore, refer in detail to the mining operations which were therein decribed. It will be seen that the various shipments of concentrates from the mine have shown satisfactory assays—that arriving in July last being better than any previous one. Advice has been received of a shipment recently arrived at Antwerp (102 tons) and of a probable further shipment of 200 tons before the close of navigation for the winter. In addition to other unforseen drawbacks and hindrances at the mine, the exceptional drought in Canada which interrupted navigation on the lake (Temiscamingue) prevented the results being realized which were confidently anticipated at the last annual meeting of the Syndicate. Mr. Walsh, the manger of the mine, having tendered his resignation a new manager (recommended by Mr. Rorbert, of Montreal, after careful enquiry) is about to be appointed. The directors are hopeful that this change will result in more rapid developments and more frequent shipments, though the latter, in any case, will shortly be suspended until the navigation is re-opened next spring."

An Appeal to Cæsar.

The Hon. Clifford Sifton, M.P., Minister of the Interior, is face to face with an important problem, the satisfactory solution of which will require the exercise of all those statesmanlike qualities which he is known to possess.

The united press of British Columbia is appealing to him as the recognized arbiter of the destinies of the Province to make a speedy decision in connection with the Government reservation of coal lands in the Crows Nest Pass. The question is removed entirely outside the sphere of politics and the most urgent appeal comes from papers which are not only Liberal but strong supporters of the Government, such as the Vancouver *Province*, and the Vancouver *Colonist*. To these must be added papers published in the immediate vicinity of the coal lands, and which may reasonably be expected to know more about the details of the question than any others. We refer to the Nelson *Economist*, Nelson *Tribune*, Rossland *Miner*, Fort Steele *Prospector*, and Fernie *Free Press*.

These papers are unanimous in declaring that the mining industry of the Province, and especially of the Kootenays, is threatened with a serious drawback in face of a possible monopoly of fuel supply by Mr. J. J. Hill who represents an American corporation.

Upon the question of railway policy and the desirability of allowing the Great Northern to build into the Kootenays nothing is said, it being fully realized that there is a broad distinction between this and the principle involved in the coal policy. There are many who think that it is an excellent thing that the Great Northern should be allowed to build, in affording greater facility of access to the States and widening the market for British Columbia mineral products. Much might be said upon both sides of this question, but we are not concerned now with the railway policy, which has practically been settled by the granting of a charter to build into South East Kootenay. We are, however, very much concerned, together with our contemporaries, with another aspect of the question, which has been patent to those conversant with mining matters for a long time past, but which has only just fastened itself upon the public mind and secured that attention which it deserves

Our readers may remember that some months ago we discussed the geographical position of the coal lands in the Crows Nest Pass with a special view to show that the policy of the Crows Nest Coal Co. was gradually excluding the Dominion Government from the only favourable position in the coal field, and that unless this policy was checked the Government would ultimately find itself in such a position that no selection of 50,000 acres could be made in accordance with the terms of the statute, which set forth that these Goverment coal lands should be of "equal value" to the other coal lands. To these allegations a strong denial was made by some of the directors of the coal company. It was stated that there was no attempt on the part of the coal company to monopolize the favourable positions and that there were plenty of places where the Government could still make their selection in consonance with the requirements of the statute. When the matter was before the Railway Committee of the House of Commons the Managing Director of the coal company pooh-poohed the idea that the whole of the valuable coal deposits were within the Pass, and stated that there were millions of tons to the east of the Rockies just as good as the Fernie coal. Subsequent developments, however, have only confirmed the opinions that were then expressed, that such a statement was absolutely devoid of foundation. It is true that millions of tons of coal have been located during last year to the east of the Rockies but so far not one seam has been discovered of equal quality to the Fernie coal or capable of producing a coke which will for one moment compare with it. This, however, is rather beside the question which is a very narrow one, viz., whether the Government can still make a selection of 50,000 acres which will give coal lands of "equal value" to those held by the Crows Nest Pass Coal Co., and secondly, what steps can be taken by the Government to prevent the creation of a monopoly in this fuel, which would for ever hamper the smelting industry of British Columbia.

Upon the first question the mining experts who have examined the coal fields are unanimous in their conclusion that only one point remains where the Government can secure what they are entitled to, viz., upon Morrissey Creek. That there should have been any hesitation on their part in deciding upon this site is a puzzle to many. However, we are not so much concerned that they should hesitate, if in the end they decide to take up what is in reality the only favourable point left for them. That they have some such intention is evident from the fact that the extensive operations commenced there by the Canadian Pacific Railway Co. and carried on during the whole of last summer have been suspended, in view of the fact that the Crows Nest Pass Coal Co. were allowed, with the full sanction of the Government, to locate a large mine on Michel Creek, outside their own freehold and upon lands which would have been available for selection by the Government, it is hardly likely that they would have caused the cessation of operations of the Canadian Pacific Railway Co. unless they had resolved in the interests of the country to select that site upon Morrissey Creek for themselves. What Mr. Sifton is urged to do by all who are conversant with the situation is to make an immediate selection of the Morrissey Creek site, so that of six strategic positions the Government will possess at least one. The coal company have two upon Michel, two upon Coal Creek, and one upon the north side of Morrissey Creek. If the Minister should fail to do this he will lose the last available site which would be of the slightest value to the country, whatever may be urged to the contrary, for explorations carried out on the eastern edge of the coal field and extending over the whole of last season, show, that except upon the coal company's freehold, there are no valuable coal areas on Martin Creek and that the coal measures on the southern fringe of the basin in the neighbourhood of the North Kootenay Pass and towards the Flat Head country are too broken and disturbed to be of economic value.

Upon the second question, as to what the Government can do to prevent the establishment of a permanent monopoly we find that our contemporaries speak with no uncertain voice, and fully appreciating the practical side of the question they go to the point at once by suggesting that having made a selection of the coal lands to the south of Morrissey Creek the Government should lease to an independent company a sufficient area to enable them to establish mining operations and effective competition. This conclusion is arrived at upon two grounds, the first being that the personnel of the whole directing influence of the Crows Nest Pass Coal Co. has undergone a change since its formation by the introduction of American interests, which to all intents and purposes now practically dominate this concern. We do not regard Mr. Hill as the "bogey man," nor do we share the fear of some of our contemporaries that he will ruin Canadian interests, but we cannot be blind to the fact that in many respects the interests of the corporation which he represents are antagonistic to our own, and no one who knows Mr. J. J. Hill imagines for a moment he has spent the money and devoted the time which his Canadian policy has cost him during the last few years for philanthropic purposes. He represents a corporation having its trunk line in the States, a line to which all the short branches which he may be able to construct into British Columbia will simply be feeders. He is also closely allied with the smelting industries of the States and it is in every way to his advan-

tage to develop the latter whatever the effect may be upon Canadian smelting. It is not a question open to dispute that the coal and coke produced in the Crows Nest Pass are superior to any in this continent, and that so far as research has gone up to date there is none other quite so good likely to be found, at any rate in the West. Manifestly then, if Mr. Hill enjoyed an absolute monopoly of this fuel he could give the American smelters the full benefit of the same and do all that lay within the power of a great transportation company so to cheapen smelting south of the line that Canadian smelters would not be able to compete. Whether such a policy is likely to be pursued may very well be gathered from the steps which have already been taken in that direction, and it can hardly be a pleasant reflection for loyal Canadians that a property which by common consent is one of the most prodigal gifts of nature, one which is absolutely unique in value and kind, should already have passed beyond the control of Canadians to whom it was originally entrusted, should have been officered and managed almost exclusively by Americans, who in several important respects, which need not here be dwelt upon, have begun to show their total disregard both for the sentiments and interest of Canadians.

The second ground upon which our contemporaries base their appeal to Mr. Sifton is that actual discrimination against Canadian interests has already taken place and if the last vantage point is conceded to the enemy we shall be defenceless in the matter.

Whilst Canadian consumers have been clamouring in the past season both for coal and coke, and have often been unable to obtain the necessary supplies to keep our smelters in operation, train loads of coal and coke have been passing daily into the States, either by way of Lethbridge and Great Falls or by way of Creston Junction and Bonners Ferry, and in the late Fall matters reached such a crisis that it was only by determined action on the part of the railway company, who refused to supply cars for the carriage of fuel to American points whilst our own smelters were unsupplied that we were able to get what we wanted.

Further, there has been a constant discrimination against Canadians in respect of the price of coke if not of coal. Coke supplied to the Great Falls smelter has been furnished as low as $3.50 a ton on cars at Fernie, whilst until quite recently Canadian smelters were paying $4.75 to $5.00. Largely owing to the clamour which this aroused and realizing the impossibility of continuing such unfair discrimination the coal company have recently made several reductions bringing the price down to $4.00 at date. This, however, has only resulted from the force of public opinion and the extreme pressure brought to bear upon them by the Canadian smelters. There is a general concensus of opinion amongst smelter experts that coal and coke at a much lower price than at $2.00 and $4 00 f.o.b. will have to be provided if the low grade ores of British Columbia are to be worked, in fact it is not going too far to say that the continued existence of the Boundary country as an ore producer is absolutely dependent on this factor. Mr. Paul Johnson, than whom no higher authority on Canadian smelting is to be found, in a recent issue stated that the cost of smelting Boundary ores had been reduced to the absolute minimum, a statement in which he is confirmed by a no less eminent and independent authority than Dr. A. R. Ledoux, of New York. Mr. Johnson further stated that the cost had been brought within a trifle of $2.25 a ton, and that of this cost no less than 63% represents fuel. With the low grade value of these ores now fully demonstrated it becomes evident how important a matter it is to secure cheaper fuel and no one doubts that the only guarantee for this would be effective competition with the only corporation producing it. No legal restrictions which could be imposed would be half so effective as a healthy commercial competition, a fact which has been already demonstrated in the history of the Crows Nest Pass Coal Co.

Whilst no one suggests that coal and coke can be produced as cheaply in the West as in the East, it is palpable that with Pennsylvania coal averaging $1.00 f.o.b. and coke $1.65, Crow's Nest coal at $2.00 and coke at $4.00 is an unreasonable figure, a fact which is further emphasized when we remember that in consequence of this cheap eastern production Pittsburg coke is actually transported three thousand miles to the western smelters and used there today.

We have all along contended that Crow's Nest coke can be produced at $2.50 and that it should therefore be sold at $3 00 per ton. We have no doubt whatever that if Mr. Sifton arrives at the decision which may reasonably be expected of him and allows effective competition to be established on Morrissey Creek, we shall within twelve months from the commencement of operations see coke of equal grade to the Fernie coke being sold to Canadian smelters at $3.00 f.o.b. and coal at not more than $1.50.

We have the utmost confidence in the determination of the Minister of the Interior to do what is fair and right to the country. He is face to face with a problem, it is true, and a more important and possibly a larger problem than is generally supposed. As was demonstrated by the last Census returns the expansion of the Dominion is practically confined to the great West, and this has been brought about mainly by the mineral development of British Columbia, which compares not unfavorably with the agricultural development of Manitoba. Mr. Sifton has made the West his study and its development his ambition. He is responsible for the construction of the Crow's Nest Pass Ry. which has been the determining factor of the opening up of the Kootenays. We are satisfied, and with confidence add our appeal to that of our contemporaries, that he will not allow any private interests nor the interests of any corporation to have the slightest weight in the matter under consideration, but that on a full consideration of the case he will be prepared to say that no combination of interests and certainly no purely American policy shall prevent the success of the great project he had in view when he fathered the western policy with which his name is identified. He must be aware of what is patent to every one in British Columbia that the control of the coal corporation for whose existence he is also responsible has passed entirely into American hands and that this furnishes an additional reason why he should identify himself with purely Canadian interests by stepping into the breach, making a prompt selection in accordance with the terms ot the statute and saying to the people of Canada, "Here are your coal lands, operate them in order that our mining and smelting industries may be free from the control of any monopoly, whether Canadian or American."

COAL MINING AND TRADE.

On another page we give official returns of the principal producing collieries in Eastern Canada during the calendar year just closed. From these and other data the output in Nova Scotia might be computed as follows:—

Dominion Coal Company	output	2,561,783
Cumberland Railway & Coal Co	shipments	341,776
Acadia Coal Co	output	270,253
Intercolonial Coal Co	output	204,402
N. S. Steel and Coal Co	(not official)	214,771
Canada Coals and Railway Co	output	68,055
Gowrie & Blockhouse Collieries	output	20,700
Port Hood Coal Co	(not official)	20,000
Inverness-Richmond Coal Co	output	13,500
Cape Breton Coal Co	output	12,754
Sydney Coal Co	(not official)	5,000
Other collieries	approximately	6,500
Or a total of		3,739,494 tons

or a gain in output of over 700,000 tons over the previous year. In our next issue we hope to review more fully some of the more prominent features of this progress.

One of the most hopeful features of the year is that the Dominion Coal Co. will be able to establish a permanent export trade; if so, this will re-act in a most beneficial manner upon their competitors, who will have a better chance in the home market. So far the efforts of this Company have been attended with a fair amount of success. Considerable sales have been made in Sweden, Norway and Denmark, mainly for railway purposes. Sales could also have been effected in the Mediterranean, but this is a more difficult market to handle and will require special care in the establishing of agencies. The general manager, however, is sanguine that within a few months the market will be opened and that it will prove to be one of the most lucrative.

The first cargo of coal has yet to go to England, but we have not changed our opinion that there is a market for this coal, especially in London, and that the result of negotiations will ultimately be to effect an introduction. Midland coal, with which Nova Scotia coal would directly compete, is now costing from 18/- to 20/- per ton in the Thames. The Dominion Coal Co. could well afford to deliver their coal for 16/-, and it is only necessary to break down the prejudice which exists and satisfy consumers that the quality is suitable for the market to ensure trial orders.

We cannot close this brief review of the year's trade in Nova Scotia without commenting upon the splendid showing made by the three large mines of the Dominion Coal Co. It is certain that no coal company in the world possesses three mines with a regular output equalling that of the Reserve, Caledonia, and Dominion No. 1, and we think the company may take equal credit for the fact that no other company is better equipped for the expeditious handling and shipping of coal.

The outlook for next year is satisfactory for the operators inasmuch as the orders already on the books give promise of a full season's work and there is little likelihood of any reduction in prices.

Of course this does not apply to export trade as the price will have to be adapted to circumstances, especially if any coal is sent to the Old Country, but in view of the condition of the iron, steel and coal trades in the United States and Canada and the enormous demand for fuel, it is not likely that there will be any weakening of price on this side of the Atlantic. We think also that during the present year at any rate there will be a demand for every ton which can be produced.

It is with pleasure that we call attention to the substantial increase in the value of Dominion Coal stock, common stock having risen from 35, at which it stood a few months ago, to 60. When it is remembered that this stock was selling as low as 8 in 1895, it will be seen what a substantial advance has been made, and this is especially encouraging because no dividend has yet been paid. The price, therefore, at which it stands evidences the confidence the public have in its ultimate value and also in the management.

Mr. T. J. Brown, who less than a year ago was appointed manager of the Old Sydney mines shortly after they were acquired by the Nova Scotia Steel and Coal Co., has just received another promotion, having been installed as general superintendent of the concern with headquarters at New Glasgow. Certainly our friend T. J. is having a great streak of good fortune. This is the third substantial promotion in two years, which reminds us of the time not so long ago when he questioned whether mining was his true calling and seriously entertained the idea of abandoning it for something else. We wish him every success in what is indeed a most important and onerous position.

We understand that the Gowrie & Blockhouse Co., who have been operating at Morien for two years under the control of Mr. Ochiltree Macdonald, has suspended operations for the present. The reason is not stated, but in view of the fact that development has been very limited and the output of coal small, we should not be surprised if it portends the adoption of some new policy for the future, as it has always seemed to us impossible for the company to recover coal from the submarine areas under the conditions at present existing. We hope that this enterprise will resume operations, as it means a great deal to the neighbourhood of Morien, which suffered so much a few years ago when the old Gowrie mine was closed down. As the Dominion Coal Co. is very short of miners there will be no difficulty in finding work for the men hitherto employed by the Gowrie & Blockhouse Co., and we understand that Mr. Shields has made arrangements to this end.

Mr John Johnston, formerly assistant manager to the Dominion Coal Co. and latterly manager of the Port Hood Coal Co., has been appointed to succeed Mr. T. J. Brown as manager of the Old Sydney mines. We congratulate Mr. Johnston as he goes to fill a historic position rendered famous by the Brown family. There can be no question that he will benefit largely by the change. We understand that the position of general manager of the Nova Scotia Steel Co. goes to Mr. Thomas Cantley, who has for many years been the commercial manager of this excellently managed and successful enterprise.

The development of mining operations in the Blairmore district, east of the Rocky Mountains, is proceeding apace, the latest news being that Mr. J. L. Frank has commenced the erection of coke ovens at his mine at Frank, Alberta. This bids fair to be one of the most promising new mines in the West as it produces an excellent quality of steam coal, and a fair, though not first-class quality of coke. The present output is 300 tons a day and it is Mr. Frank's intention to develop a capacity of at least 1,000 tons. He deserves success, for he is one of those Americans who have benefitted Canada by the liberal expenditure of capital, which already approximates $250,000 00. He has also established a town of which any district might well be proud. It is constructed upon modern sanitary lines with all the necessary public buildings and conveniences. Other investors in the same coal field are bringing in plant and machinery for more extensive operations next season, so that Blairmore and the district is likely to be a very busy place in 1902.

Although the final figures are not to hand we gather that the output of the Crow's Nest Pass Coal Co. last year will be slightly in excess of 400,000 tons, an increase of about 90 per cent. over the previous year. In addition some 200 coke ovens have been added, so that the present capacity is 1,000 tons of coke daily, and we believe the capacity of the mines is not much below 2,000 tons. This shows satisfactory progress since the advent of the new management and justifies the expectation that by degrees Mr. J. J. Hill's enormous total of 10,000 tons daily will be reached. Of this output more than 80 per cent. was produced at Coal Creek, the operations at Michel not yet having been so successful as one could wish. There is every expectation, however, that the new mine on Morrisey will be as good if not better than the Coal Creek mine. The measures at this point are very regular and solid. Five seams have been exposed on the north side of Morrisey Creek and there are two others a little distance away which will no doubt be traced to the Creek. These seven seams would give an average of 152 feet of workable coal.

A branch line has been built under the new charter from the Crow's Nest Pass line to within one mile of the mine where it terminates in consequence of the narrowness of the pass. To this point an electric tramway has been constructed to convey the coal from the mine. The railway is not quite finished, but will be in operation in the course of two months, and as there is every facility for speedy development there is no reason why a fair output should not be obtained during the coming season.

There have been several important discoveries of coal in the Similkameen Valley and one large company has been formed under the title of the Similkameen Valley Coal Co. with $1,000,000 capital. A first call realizing $50,000 has been paid and the services of Mr. W. Blakemore engaged as consulting engineer. Under his directions boring operations will be commenced in March and a drill is now being shipped in for that purpose. The coal seams exposed at the surface are lignitic, but there is every reason to believe that beneath these good bituminous seams will be found. A second syndicate with the Hon. G. E. Foster as president has been formed in Toronto by Messrs. Hall & Murray, the well known brokers, who have also engaged the services of Mr. Blakemore as consulting engineer. They will explore coal lands adjoining those of the Similkameen Valley Coal Co. The future of this property will depend entirely upon the construction of a railway through the valley, and to this end every effort has been made to induce the British Columbia Government to move in the matter this year, so that the resources of this fertile valley, both mineral and agricultural, may be marketed. It is not merely for coal and agricultural purposes either that a railway is required, for some of the best copper properties in British Columbia lie between the Boundary district and the Hope Range of mountains, notably Nickel Plate on Twenty Mile Creek and Copper and Kennedy mountains, nearer to Princeton.

The latest information relates to a discovery of bituminous coking coal near Fire Valley twenty miles west of lower Arrow Lake. Here a 4-ft. seam has been discovered and on careful analysis has been found to yield 62.8 per cent. of fixed carbon and 8 per cent. of ash, giving by slow coking a firm, coherent coke. This property, which consists of 6,400 acres, has been bonded by Mr. Blakemore until the first of November, 1902, and it is his intention to make a thorough proof of the seam during the present season. If the coal should be found of sufficient extent to justify the establishment of a mine, its proximity to the smelters of the Boundary district as well as those at Trail and Nelson would give it a preference in the market as it would be at least 100 miles nearer than the product of the Crow's Nest Pass Coal Co.

Characteristics of the Atlin Gold Field.

By J. C. Gwillim, B.Sc., M.E., Nelson, B.C.

The mountains about the eastern shore of Atlin lake are not rugged. They have rather a worn down appearance. If one passes eastwards behind them no great deep valleys are found on the other side but great tracts of evenly sloping ground above and at the timber line; the streams do not appear to have cut deeply into this great mountain mass, which lies immediately about and behind the gold bearing streams.

In considering the two principal placer bearing streams, Pine and Spruce creeks, the valleys in which these streams run appear much too wide and flat bottomed to be the result of the cutting out action of such streams as the present Pine and Spruce creeks.

Both of these streams flow in sharply cut gutters through the general level of the broad valley bottoms, Spruce Creek in places having cut a deep trench two to four hundred feet below the general valley surface.

Leaving out as much of the theoretical origin of these valleys as is advisable, the observed facts appear to point to the conclusion that the present streams did not wear out or form these great valleys.

Above the junction of Pine and Spruce creeks the main valley is over 2 miles wide and at 6 miles east of the lake is 600 feet above it. With such a fall and an uninterrupted period of time to operate in the present streams should have cut out a V shaped valley.

Spruce valley trending off to the south-east rises gradually by its broad valley to the level of the upland slopes or moors previously mentioned, a height of about 1,700 feet above Atlin lake.

Pine valley goes eastwards to Surprise lake, eleven miles from Atlin lake and 825 feet above it.

These broad raised valleys are floored with serpentine, magnesite, diorite and diabase. The mountains about them are composed of the same material together with some patches and bands of a very granular friable limestone, and a cherty quartzite capable of breaking up into small fragments very easily, and actinolite slates. These rocks with the possible exception of the diabase and diorite appear to belong to the lower Cache Creek series, a formation recognized at various places in a like relation east of the granite Coast ranges for many hundred miles on a south-easterly trend. The Cache Creek series of rocks has been found to be placer-bearing elsewhere. In the Atlin district it is amongst the more basic and magnesian portions of the series that paying placer has been found. Such as the rocks of Pine and Spruce and McKee valleys.

The rock surface or bed-rock underlying the valley of Pine and Spruce Creeks appears to be uneven in a minor degree, there are a few low out-crops of diorite, diabase and serpentinized rock. These inequalities are hidden to a great extent by terrace deposits up to a height of about 600 feet above the lake. Farther up the valleys, at higher levels, there are irregular ridges of drift material and little lumpy hills of clay, gravel and boulders and, on Spruce Creek, these finally give place to the smooth easy slopes of the upland moors above timber line. The occurrence of deep ditch-like canyons made by the present streams appears to indicate that these streams have been rapidly cutting new channels in the old valley for a limited period since the lake receded to its present level.

These streams have cut down through superficial deposits of clay, boulders, gravel and sand. All of which are largely composed of the local rock material. At places this material is false bedded gravel and sand; at other places it is a stiff grey boulder clay containing striated boulders.

On Spruce Creek the present stream has cut through this grey and blue drift material to a depth of two or three hundred feet. It has also cut through bands of diabasic rock forming canyons

Beneath the drift and at about the level of the present stream bed, the action of the stream and the workings of the miners have shown large deposits of yellow gravel, so far traced for about two miles on Spruce Creek, from a point a little above Discovery Claim to about No. 100 below Discovery.

This yellow gravel represents a stream bed formed prior to the drift deposits which now overlie it. It contains gold values sufficient to cause it to be worked on 94 below by wheeling out of a tunnel into the sluice boxes. Near 100 below it is said to have returned six dollars to the yard. At Discovery, two miles above, the bench formed the old yellow gravel bed rock and this has been worked out.

On Pine Creek a somewhat similar deposit is found, but is not here overlain by drift material. A superficial area of this yellow gravel near Willow Creek adjoining Pine, of 100 feet square is said to have cleaned up over three thousand dollars. There is no doubt that these yellow gravels represent pre-glacial stream beds having much the same drainage and depth as the present Pine and Spruce creeks.

These gravels are in an advanced state of decomposition. Outwardly they appear to be composed of rather large shining yellow pebbles in a paste of yellowish mud. They are not usually cemented.

The paste containing the pebbles is apparently nothing more than the completely rotted or decayed gravel of smaller size. The large pebbles easily break with a yellow oxidized fracture, and are of the

same rock as the very tough greenish boulders so prevalent in the present stream bed

The thickness and width of these yellow gravels is perhaps somewhat greater than the corresponding deposits of the present stream beds. They were not observed at any point lower down in the valley than about the level of the present surface terraces five to six hundred feet above Atlin lake.

The gold contents of these pre-glacial streams are concentrations from the wearing out of the pre-glacial valley, and appear therefore to have been locally derived. The change of conditions which brought about the filling in of the pre-glacial stream beds with the drift gave these valleys their present superficial flooring. The post-glacial streams had therefore to cut out new channels for themselves through this drift, and there is evidence to show that several minor channels were formed before the present ones fixed the drainage.

Any such temporary stream bed would concentrate more or less placer gold from the drift which it disposed of, and this accounts for the gold in some of the dry or nearly dry runs, found in these broad valleys.

It is not likely that any of these minor superficial depressions indicate the position of the older pre-glacial stream, excepting where the contour of the rock floor beneath might force the new stream to cut down the drift in its former depressions

Gold Run, Willow Creek and Trand Gulch may or may not have been the courses of pre-glacial streams—evidence goes to show they were not—but in any case these channels were formed *since* the covering of drift and being in drift still, show no evidence of the pre-glacial drainage. Gold Run is said to have yellow gravel about 30 feet below the superficial channel. Willow Creek is a former channel, on bed-rock, of the present Pine Creek. Trand Gulch has shown no yellow gravel from its pits and shafts, but is a well defined shallow depression now almost dry. The placer gold of the runs and creeks in the valleys of Pine and Spruce seems to have been derived entirely since the period of glacial drift from concentrations of this drift and re-washing of the pre-glacial stream bed by present or past glacial streams. There appears to be, or to have been, no considerable amount of gold added by reason of the denudation or wearing down of the surrounding mountains since the deposition of the drift.

In this they differ from the placer concentration of the minor V shaped creeks tributary to Pine Creek, such as Birch, Boulder, Ruby and Wright. These last named creeks are typical, lateral V shaped streams heading in mountain basins and still cutting down the trough through bed-rock. They carry no apparent evidence of glacial action, the stream beds are filled in with boulders in most places. Bed-rock is usually more in evidence about the middle portions of these streams. This seems to be due to the fact that the upper basins keep filling in with talus while the lower portions are filling up with gravels.

The bed-rock is often actinolite slate, and on Wright Creek is an argillite or soft black shaly slate. Boulder Creek shows an instance of gold on granite bed-rock on its upper portion, not elsewhere found in the district. The bed-rock is granite and the basin at the head of the stream is granite, but the great mass of rock which formerly filled this valley was of the gold-bearing slate variety, and its gold has been concentrated as the stream cut down to the underlying granite.

Ruby Creek has so far been unproductive; originally this creek had cut down more deeply than the other lateral streams through the rocks favorable to placer gold. At a later time it appears to have been partially filled in by a basaltic flow from an extinct volcano on its western side. The stream has not yet cut down through this basaltic covering to the gravels beneath. The glacial drift which lies as an overburden of from a few feet to over three hundred feet in depth in the Pine-Spruce Valley carries gold prospects in most unlikely places, apparently, such are found amongst the little lumpy hills far up on Spruce Creek. Prospects have been found in the gravel on the exposed summits of these moraine-like deposits; such may be due to a weather concentration by which the lighter materials have been removed leaving a little gold and the gravel behind.

Such a flooring of more or less assorted drift material will naturally contain considerable gold in a more or less concentrated condition; for this drift represents great masses of the gold bearing country rock and vein material of these valleys, and their pre-glacial wash or surface. It is possible that there may be some fairly rich concentrations of gold within the drift itself wherever contemporary streams had their courses during the deposition of this material and it follows that any later stream cutting out and re-washing this drift does little more than concentrate an equal volume of country rock, excepting where it may cut into some such concentration of values. There appears to be some evidence that Pine Creek has cut some earlier concentrations other than its own bench or former stream gravels, and the yellow gravels.

On the south bank of Pine near Discovery there are pay gravels which, from the present contour of the surface, do not appear to underlie any stream bed more recent than the deposition of the drift, and these are not yellow gravels.

It will be seen that in these wide flat valleys the streams are not now actively concentrating gold from the mountains about them, and that wherever the present small troughs of these streams traverse the unassorted drift they are not likely to have gathered much gold. Hence their richness depends upon their cutting some earlier concentrations which may be in the drift material itself but is more often the pre-glacial yellow gravel. This deposit as already stated exists at about the level of the present stream beds.

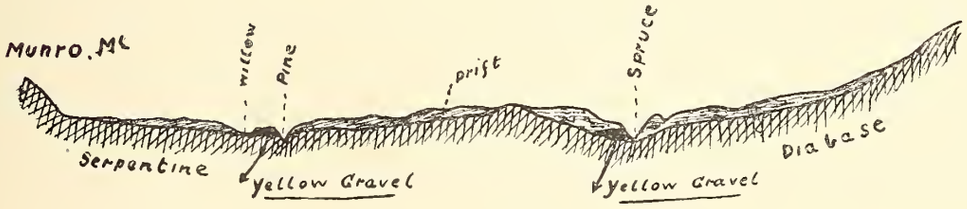
The portions of Pine and Spruce creeks now being productively worked coincide with portions of these yellow gravels which have been at these places more or less cut into and re-sorted. That is from Discovery to 140 below on Spruce; and from Gold Run to Stephendyke on Pine. If the gold is derived in this manner it follows that the bench gravels or former courses of Pine and Spruce will not be found to be rich, excepting in such cases as Willow Creek and Stephendyke where the earlier courses are themselves below the bed-rock of the yellow gravels and have received enrichment from them. At horizons *above* the older deposit, the earlier stream beds or benches contain only what has been concentrated from a very limited amount of drift material, more or less gold bearing according to the amount of concentration it has undergone.

Concerning the origin of the placer gold there are, as is common, reports of mother-lodes. Certainly there are many well defined quartz veins in the district but these as a rule are not rich in free gold. Some large bodies of country rock such as magnesite, and the shaly slates of Wright Creek carry mineral sulphides and more or less gold. There is also some rich gold bearing rock crossing Pine Creek near Willow. This has been credited with mother-lode properties but it does not account for the gold on Birch, Boulder, and Wright and Otter which lie above and eastwards of it.

It is not likely that any great vein or system of veins originally contained this gold, but rather that the different varieties of country rock which limit the field productively are gold bearing either in themselves or in the various forms of dykes, veins, and stringers or segregations of secondary material. At no place has gold been found at all comparable in coarseness with that of the placers, and its fineness varies on different creeks These characteristics of coarseness and variety may or may not have belonged to the original gold *in*

CHARACTERISTICS OF THE ATLIN GOLD FIELD.





Hor scale 2 (in) = 1 Mile Vert Scale 1 (in) = 1000 ft

Cross-section of Pine-Spruce valley from Willow Creek to № 94 below on Spruce

situ. The useful results of observation appear to be as shown in this paper that the placer gold is of local origin and that it is found associated with certain distinct rocks not necessarily gold bearing elsewhere, but shown to be so in this district, and that there are certain recognized factors in the enrichment of the gravels.

The Atlin district was first opened up in 1898.

In 1899 about three quarters of a million dollars was taken out.

In 1900 and 1901 the Atlin "Claim" gives the following outputs for the different creeks in ounces:—

	1900	1901
Pine and Willow	4918	5330
Spruce	1699	2308
Boulder	1916	2640
McKee	1733	1013
Wright	1068	283
Graham	19	103
Otter	122	143
Birch	15	271
Gold Run	——	31
Totals	11490 ozs.	12122 ozs.

A total of about two hundred thousand dollars for each of these years. This being only the official record and less than the real production.

The falling off is due to the transition from placer to hydraulic mining in a large degree. There is much ground fit for hydraulic working if a sufficient amount of water is obtainable.

McKee Creek appears to combine some of the characteristics of drift deposits and a V shaped valley. No yellow gravel is known to occur but its presence is possible.

The photos and cross-section sketch will illustrate the character of the Pine-Spruce Valley at its principal placer bearing horizon.

COMPANY NOTES.

Le Roi No. II.—The report of the directors of Le Roi No. 2, Ltd., for the year ended 30th September last, states that it had been the intention of the Board to call the shareholders together early this month, but it was found impracticable to do so, at all events, before the month, as the audited accounts could not be received in time, owing to the fact that the auditors requested, late in October, that their representative should proceed to Rossland for the purposes of the audit. The directors have, therefore, thought it would best suit the convenience of the shareholders to defer meeting until after the holidays, and have fixed the date for 9th January, prior to which time the accounts will have been received, and the shareholders will also have the advantage of the presence of Mr. Bernard Macdonald. In his report, Mr. Macdonald estimates the amount of ore blocked out and in sight at 240,000 tons. He shows the net profit on the ore shipped up to 30th September was about $6 a ton. He states that the present plant is capable of dealing with 250 tons per day. It will, however, be observed from the details of results of ore shipped in October and November, already furnished to shareholders, that the above output has not yet been reached, the amounts treated being:—October, 4,060 tons or about 150 tons per day; November, 4,800 tons, or about 185 tons per day. On the other hand, however, the profit per ton has exceeded the previous results, being for October at the rate of about $7 per ton, and for November about $8 per ton. With reference to the items which will appear in the accounts as due to the Bank of Montreal and the Northport Smelting and Refining Company, the latter has since been liquidated, whilst the profits earned during the current month should more than suffice to complete the repayment of the former. There is also an amount of over £20,000 still to be received from the British America Corporation. With reference to the payment of this sum, together with interest, satisfactory arrangements have been made with the special manager of the British America Corporation, acting under the authority of the Court. The Board desire to record their appreciation of the satisfactory way in which Mr. Macdonald has developed and generally conducted the operations at the mine during the period under review, and in particular to testify to the ability and energy with which he has dealt with the recent serious strike. The foregoing statement is personally corroborated by Mr. A. B. Dealtry, one of the directors, who has recently returned from the mine. Mr. R. E. Leman and Mr. H. Pelham-Clinton, two of the original directors, have resigned, and on the 4th December, 1901, the following gentlemen were appointed to seats on the Board:—Lord Ernest Hamilton, Mr. Frederick C. D. Haggard, and Mr. Reginald Noton Hincks. Mr. Sinclair MacLeay has resigned the chairmanship, which has been accepted by Lord Ernest Hamilton. Mr. Sinclair MacLeay and Mr. Tyndale White retire from the Board, and offer themselves for re-election. In the general manager's report it is stated that during the period under review the gross expenditure on account of mining operations amounted to $277,624.37, made up as follows:—Expenditures on revenue account—Stoping ore, No. 1 mine, $30,052.64; stoping ore, Josie mine, $54,017.92. Expenditure on capital account—Exploration and development, No. 1 mine, $70,205.08; exploration and development, Josie mine, $99,242.49; mine equipment, No. 1 mine, $3,442.24; mine equipment Josie mine, $9,609.19; mine machinery, No. 1 mine, $2,722.62; mine machinery, Josie mine, $1,133.23; surface improvements, No. 1 mine, $5,667.73; surface improvements, Josie mine, $1,531.13. The amounts chargeable to revenue account are:—Stoping ore from mines, $84,070.56; depreciation, mine exploration and development, $3,079.68; depreciation, mine machinery and plant, $385.59; depreciation, surface improvements, buildings, $719.88; depreciation, mine equipment, $2,610.28; a total of $90,865.99. There were produced from the mines and shipped to the smelting works a total of 24,689 dry tons of ore. The total cost of production per dry ton is as follows:—Stoping and loading on railway cars, $3 40. Depreciation —Mine exploration and development, $·125; mine machinery and plant, $·015; surface improvements, buildings, $·030; mine equipment, $·010; total cost for mining and loading on railway cars, $3.58. From the beginning of the company's operations to 30th Sept. there were shipped to the smelter 24,689 tons of ore (dry weight) containing gross value as follows:—11,331.24 ozs. gold at $20, $226,624.80, or $9.18 per ton; 37,898.37 ozs. silver at $.60, $22,739.02, or $.92 per ton; 1,131,160 lbs. copper at $.16½, $186,641.41, or $7.55 per ton, making the total gross value $436,005, the average gross value per ton being $17.65. The cost of mining and loading on railway cars was $3.58. Smelter charges as per contract—Freight and treatment, $6; indirect charges—that is, contract deductions from gross metal values, $1.98, making the total cost of realization $11.56, leaving net value per ton (profit), $6.09. In concluding his report the general manager observes that it is very satisfactory to review the result of the past year's operations of the property, and to be able to confidently forecast even more favorable results for the future. The 240,000 tons of ore blocked out from the surface downward to the 500 ft. level are now ready for stoping, and the noticeable improvement in the size of the ore bodies, so far as depth has been attained on them, is very gratifying, and inspires confidence. That pay ore will extend to the deep is strongly answered in the affirmative by the general dimensions and favours able characteristics of the ore bodies at the greatest depths attained on them. The extensive area of the company's property, stretching, as it does, across the trend of the great mineral zone of Rossland, possessing within its boundaries most of the pay ore veins of the camp, bespeaks for the future of the property immense possibilities. Already the mines are firmly established on a dividend-paying basis, and it is a pleasure to feel warranted to forecast the continuance of this condition indefinitely.

Superior Copper Co.—The output last year from this company's mines, which are situated about three miles from Superior Station on the Algoma Central Railway, was about 1,500 tons of ore, averaging about 6 per cent. in copper, $2.00 in silver and $1.00 in gold values per ton. Bids for the machinery equipment of the mine are out. The manager of the company is Mr. J. P. Moran, and the head office of the enterprise is Sault Ste. Marie, Mich.

Molly Gibson.—Contract has been let for 1,000 feet drifting at No. 5 tunnel, to be pushed as rapidly as possible. Ore sales last two weeks of December, 1901, totalled $6 404.56, being an average of $100.21 per ton net yield. No. 5 tunnel is now in 150 feet and will be extended at rate of about 60 feet per month. On January 16th there were about 800 tons ore sacked ready for shipment. Work at all parts of the mine is being proceeded with vigorously and it is expected shipments will be continuous.

Canada Consolidated.—Annual Meeting held Jan. 9, 1902, at which the reports submitted showed the Company to be in a prosperous condition. The purchase of extensive graphite properties is contemplated and if negotiations now under way are successfully consummated extensive work will be undertaken at once.

Arctic Slope Hydraulic.—Clean-up for past season was not as large as was hoped, owing to the season's being late in opening and the ice taking early in the Fall. New flumes have been built and another monitor will be sent in next spring. Wit these improvements it is hoped substantial increase in the gold account may be noted.

Rock Lake Mining.—The directors who have returned from an inspection of the mine and concentrating mill express themselves highly pleased with the progress of the company's operations. The mines have been developed by putting in cross-cuts at different intervals along the vein over a distance of two miles and shafts have been sunk, the main one to the distance of over 425 feet, which shows a vein from 24 to 45 feet in width the entire depth. The mine and concentrating mill are in operation and concentrates will be shipped in the next three or four weeks to the smelters in northern Michigan. The directors were accompanied by Mr. John J. Case, a smelting expert, who was investigating the property and adjacent mines of the district on behalf of a syndicate which proposes to put up a copper smelting plant. It is understood Mr. Case's report will be favorable to the project. A plant of a capacity of 800 tons per day is contemplated.

Dolliver Mountain Mining & Milling Co.—In a letter to the REVIEW, Mr. G. J. Partington, the energetic manager of this enterprise, describes the progress being made with the opening out and equipment of this promising property at Isaac's Harbor, N.S. He writes: "It may interest you to know that we have been pushing the work here with all possible speed. Our dams, 4,200 ft. of flume, large penstock, and a power-house are all finished. The electric, air compressor, and water-wheel machinery are also on the ground and we are just about to install same. The only thing lacking to complete the work is 500 ft. of 44-in. steel pipe to connect penstock to water-wheel. This pipe is expected daily in Halifax and on arrival will be rushed down to us. We have had quite a battle here, but have won out so far, and trust to be able to turn on the electric fluid some time in February. But the greatest victory of all is our mining work In the prospecting, or preliminary work, undertaken to gain sufficient knowledge of the property to decide the location for our vertical shaft, I uncovered and traced three ore bodies around the fold or saddle, at sufficient distance apart to obtain a fairly

accurate idea of the course of the axis of the anticlinal. The vertical shaft was then located. As we intend to sink this shaft to a depth of 1,000 ft. and expect to have it supply ore to keep 120 stamps busy, provision had to be made to take care of this tonnage when we reach the productive stage. I therefore decided that we should have two hoisting ways and a compartment for ladders, pump and air pipes, and service cage. To do this our shaft in the rock must be 20 ft. long by 8 ft. wide. The surface, through which we had to sink, proved to be quicksand from the grass roots, and to combat that and the depth which, to some extent, was known, I had to start the surface shaft 35 ft. long by 20 ft. wide. It would be difficult to write at length an account of the battle royal this furnished, but we won the shaft to the bedrock, leaving sufficient room to bring up our permanent cribbing and a space for tamping in clay to act as a cofferdam, thus giving us a dry shaft so far as surface water was concerned We passed through 55 ft. of quicksand and uncovered the bedrock in a choice position, the crown, or axis, of the anticlinal being exactly in the centre of the shaft, with the north, south and east dips well defined. The rock uncovered was smooth, almost polished, and is evidently the quartzite footwall of an ore body just east of the shaft. We are now 8 ft. in this rock and have suspended work pending the installing of permanent timber. About 30 ft. of this timber is in place and cofferdammed and the work is being pushed with all possible speed. When finished we trust to be nearly ready to start work with air drills, but if not will continue with hand steel until the drills may be used. Our mill site has been graded and the foundation walls practically completed, so we may start the erection of building very early in the spring. This building will be 154 ft. by 69 ft. and will cover 80 stamps, with concentrators, etc.

Velvet (Rossland).—It is proposed to reconstruct the company, the scheme providing for an assessment of 2s. 6d. per share, which will produce a sum of £25,000. A meeting of shareholders is called for the 8th inst. to consider the proposal.

The Late J. Roderick Robertson.

The last form of the present issue of the REVIEW had gone to the printer before a brief despatch in the evening paper conveyed the sad intelligence of the accidental death in New York of our old friend Mr. J. Roderick Robertson, of Nelson, B.C. Mr. Robertson, it appears, was sitting in his room at the Murray Hotel, when a tremendous explosion of dynamite occured in a structure at 2nd Street and Park Avenue, used by the contractors of the Rapid Transit Subway, a quantity of iron was thrown through his window and struck him as he sat in his chair, killing him instantly.

Mr. Robertson was the General Manager of the London and British



THE LATE J. RODERICK ROBERTSON,
General Manager of the London & British Columbia Gold Fields, Nelson, B C., accidentally killed in New York, 27th January, 1902.

Columbia Gold Fields, one of the largest, best managed, and most successful British corporations operating mines in British Columbia, and much of the success of this enterprise was due to his keen foresight and sound business methods. Mr. Robertson was also the President of the British Columbia Mining Association. A Scotchman by birth, Mr. Robertson was widely known and greatly respected not only in British Columbia but in other parts of Canada. He was in every sense a lovable character and will be greatly missed particularly by the mining fraternity of Western Canada.

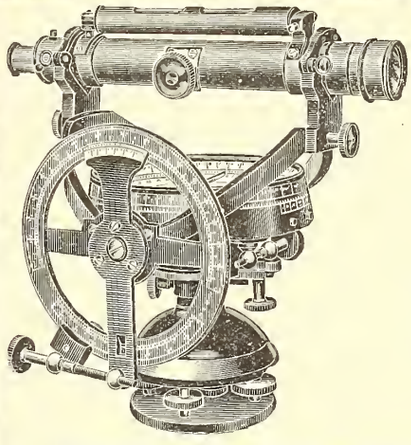
Black Eagle Gold Mining Co. (Regina Mine)—The following is an extract of letter received by the company from their manager on the 4th inst.: "I started the machinery yesterday (19th December, 1901) and everything, as a whole, works like a clock, barring a few minor details, which, as usual in starting a large plant like this require adjusting At the end of another week thirty stamps will be kept dropping night and day for the month of January, and on the last day of that month I will make my first general monthly clean up, when results satisfactory to all concerned may be expected, and, I feel confident will be realized."

Bosun Mines.—Manager reports 180 tons galena shipped during December. Smelter returns for 160 tons $5,935.

General Mining Association of the Province of Quebec.

The Annual General Meeting of the Association will be held in the Library of The Canadian Mining Institute, Room IV., Windsor Hotel, Montreal, on Wednesday, 5th March, 1902.

G. E. DRUMMOND, *President.* B. T. A. BELL, *Secretary.*



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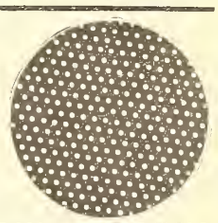
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Gold Medals, Inventions Exhibitions, 1885, and Mining Exhibition, 1890

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(B) Chemistry and Mineralogy.
(C) Mineralogy and Geology.

3—Courses in Chemistry, Assaying, Mineralogy,

and Geology for degrees of Bachelor of Arts (B.A.) and Master of Arts (M.A.)
For further information see the Calendar of Queen's University.

4—Post-Graduate Course for the Degree of

Doctor of Science (D.Sc.)
For further information see the calendar of Queen's University.

Next Session begins October 3rd,

. . . 1900 . . .

Matriculation Examination held at Queen's University, Sept. 20th.
Unmatriculated Students admitted to Special Courses.

The School is provided with well equipped Laboratories for the study of Chemical Analysis, Assaying, Blowpiping, Mineralogy, Petrography and Drawing. In the Mining Laboratory the operations of Crushing, Amalgamating, Concentrating, Chlorinating, Cyaniding, etc., can be studied on a large scale.

FOR CALENDAR OF THE SCHOOL AND FURTHER INFORMATION APPLY TO

Dr. W. L. GOODWIN,

DIRECTOR

SCHOOL OF MINING, KINGSTON, ONTARIO.

Did You Hear the Thunder?

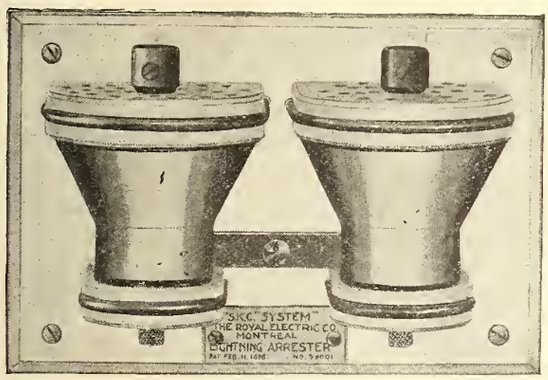
Where there is thunder there is lightning. Every electric plant should be provided with Lightning Arresters which will **PROTECT!**

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CANADIAN MINING INSTITUTE

ANNUAL MEETINGS.

The ANNUAL GENERAL MEETINGS of the MEMBERS of THE CANADIAN MINING INSTITUTE, for the Transaction of Business, the Discussion of Papers, etc., will be held in the

CLUB ROOM, WINDSOR HOTEL, MONTREAL,

On Wednesday, Thursday and Friday, 5th, 6th and 7th March, 1902.

SINGLE FARE ON RAILWAYS.

Arrangements are being made whereby Members will be carried to Montreal and returned for a **Single Fare** on the Canadian Pacific, Grand Trunk, Intercolonial, Quebec Central, and Canada Atlantic Railways.

SPECIAL TOPICS FOR DISCUSSION.

In addition to a record programme of papers to be presented by the most eminent mining authorities in Canada, the following Topics have been slated by the Council for special discussion :—

GOVERNMENT AID TO MINING.
By Mr. JOHN E. HARDMAN, S.B., M.A.E., Montreal, Que.

COMPRESSED AIR.
By Mr. W. L. SANDERS, New York, N.Y.

COLLIERY VENTILATION
By Mr. CHARLES FERGIE, M.E., Westville, N.S.

POWER DRILLS.
By Mr. C. C. HANSEN, Montreal, Que.

HAULAGE.
By Mr. WM. BLAKEMORE, M.E., Montreal, Que.

PUMPING.
By Mr. JOHN P. NORTHEY, Toronto, Ont.

Syllabus of papers and detailed programme of arrangements will be sent to members in due course.

CHARLES FERGIE, *President.* B. T. A. BELL, *Secretary.*

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The Canadian Mining Manual

FOR 1901

Up to date particulars of the Organisation, Equipment, Operations, Output, Balance Sheets and Dividends of all Canadian

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The most complete and handily arranged work of reference to Canadian mining undertakings extant.

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THE CANADIAN MINING REVIEW

OTTAWA, CANADA.

PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

PROVINCE of QUEBEC

The attention of Miners and Capitalists in the United States and in Europe is invited to the

GREAT MINERAL TERRITORY

Open for investment in the Province of Quebec.

Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at the mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE HON. THE COMMISSIONER OF COLONIZATION AND MINES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order in Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's Certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end on the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 an acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee $5.00 renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed in the river below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent. on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River and Hill Claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer Claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim, and each person in his or its employment, except house servants, must hold a Free Miner's Certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of five per cent charged on the gross output of the claim, with the exception of an annual exemption of $5,000.00.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek or gulch, but the same miner may hold any number of claims by purchase, and Free Miners, not exceeding ten in number, may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch or river, by giving notice and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00 and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette.*

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, and a royalty of five per cent. on the gross output, less an annual exemption of $25,000.00 are charged. Operations must be commenced within one year from the date of the lease, and not less than $5,000 must be expended annually. The lease excludes all base metals, quartz and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite : copper in sulphide and native form ; gold, mostly in free milling quartz ; silver, native and sulphides ; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

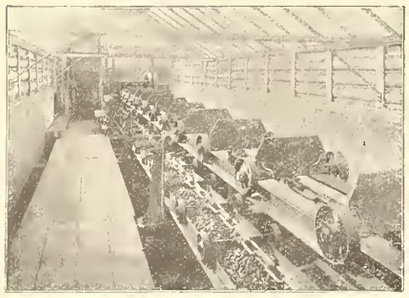
For reports of the Bureau of Mines, maps, mining laws, etc , apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

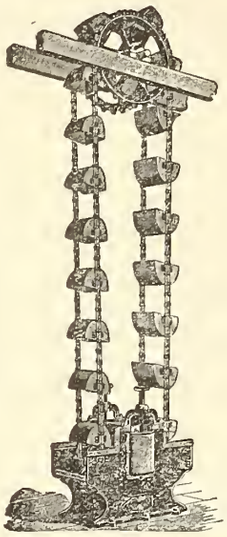
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THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

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Coal and Ashes Handling Machinery





Freight and Package Elevator

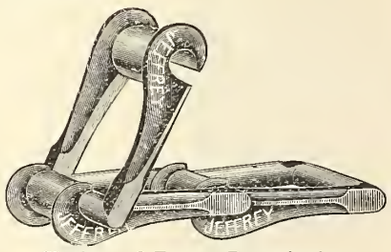
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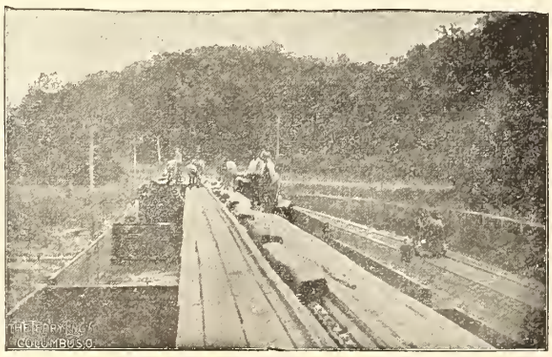
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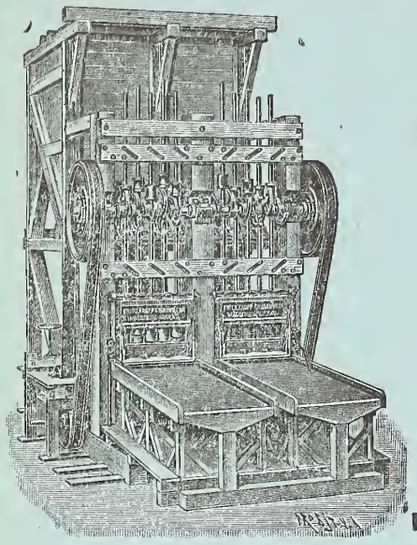
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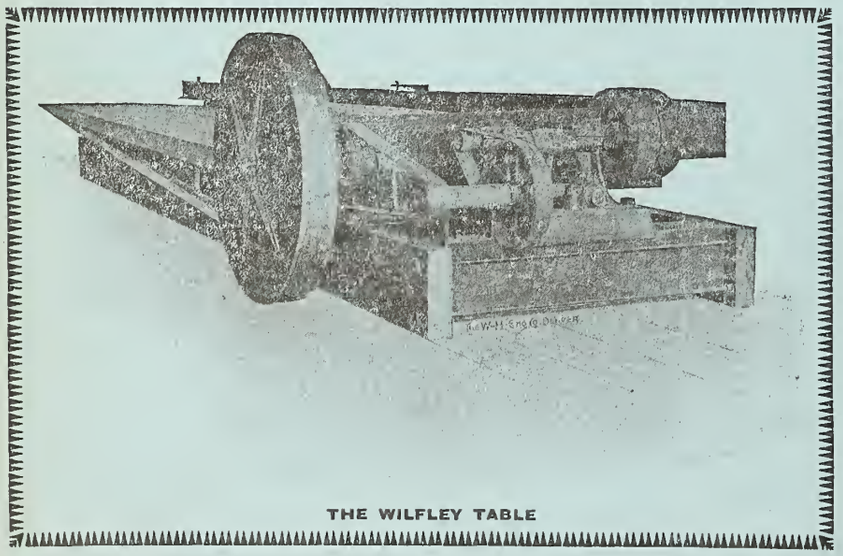
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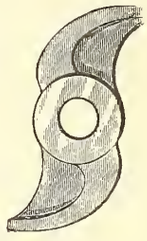
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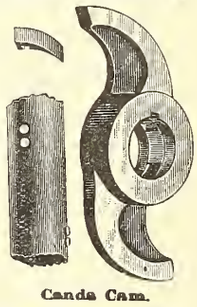


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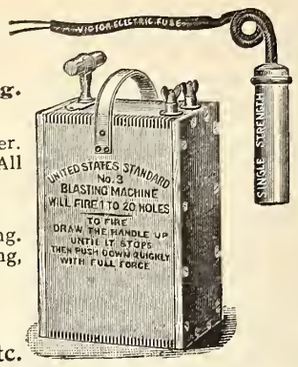
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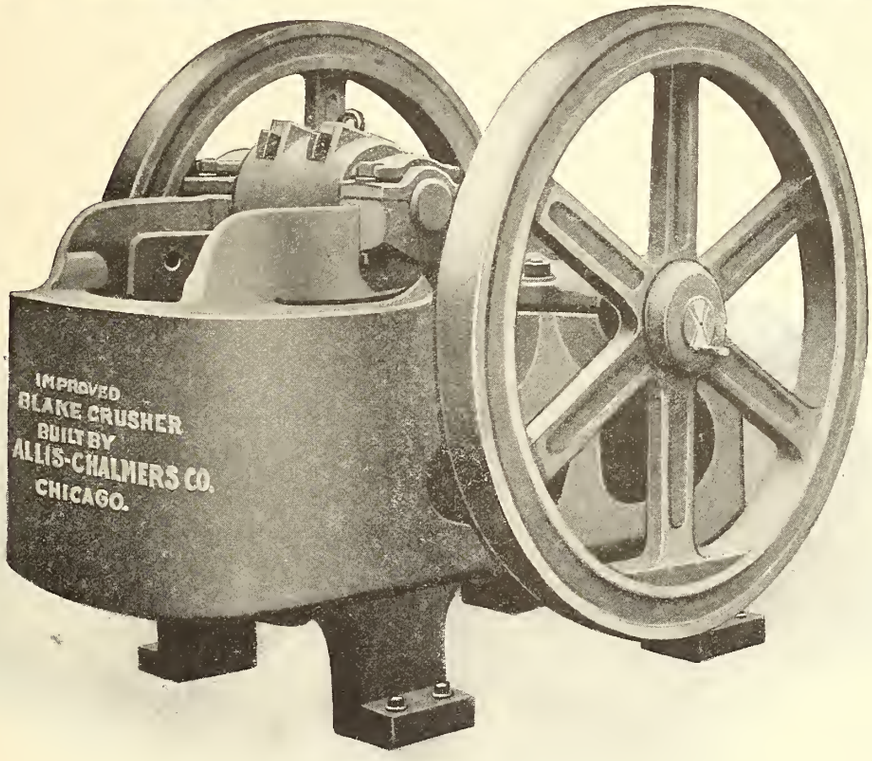
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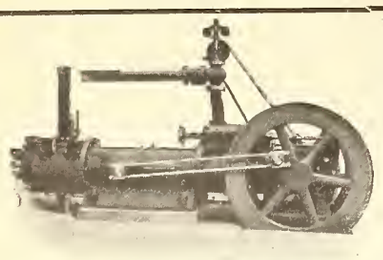
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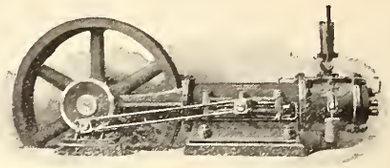
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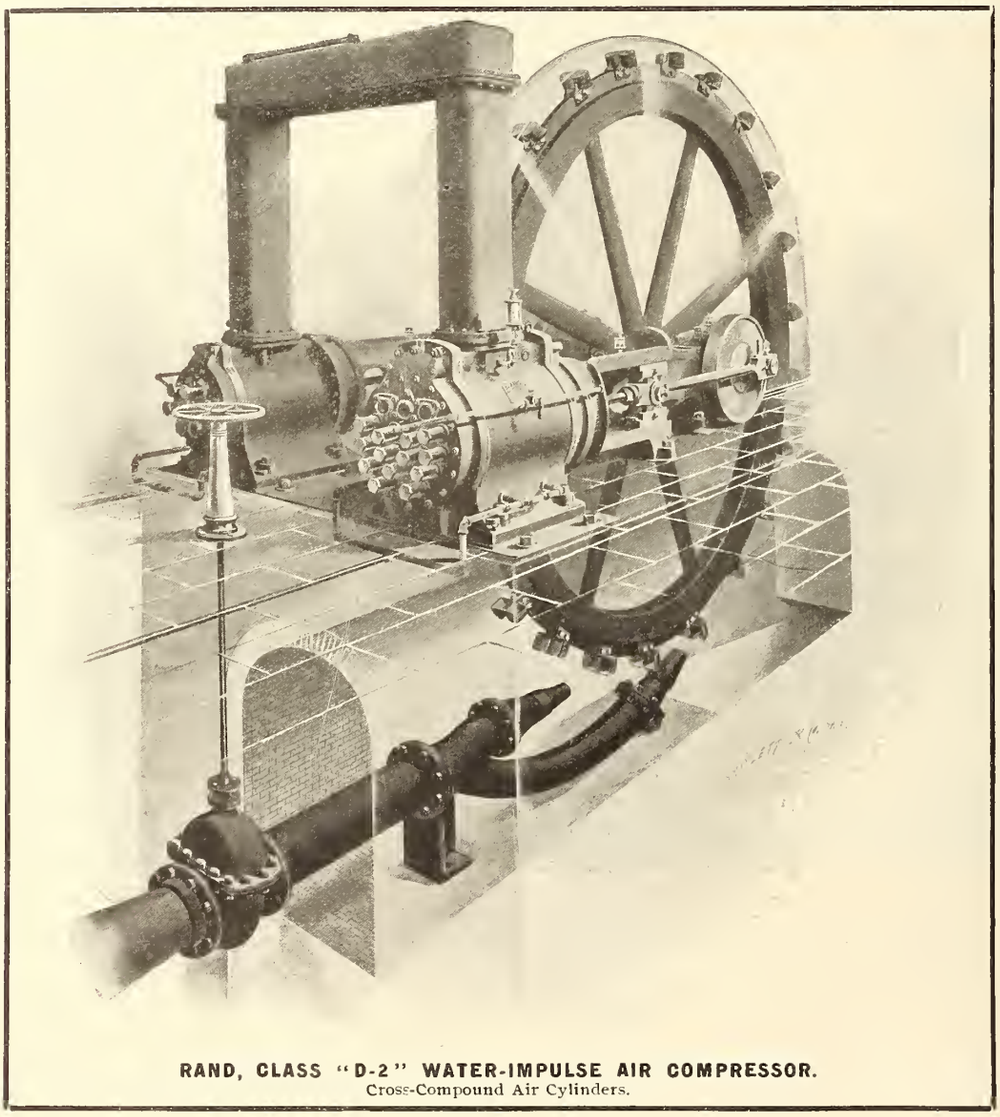
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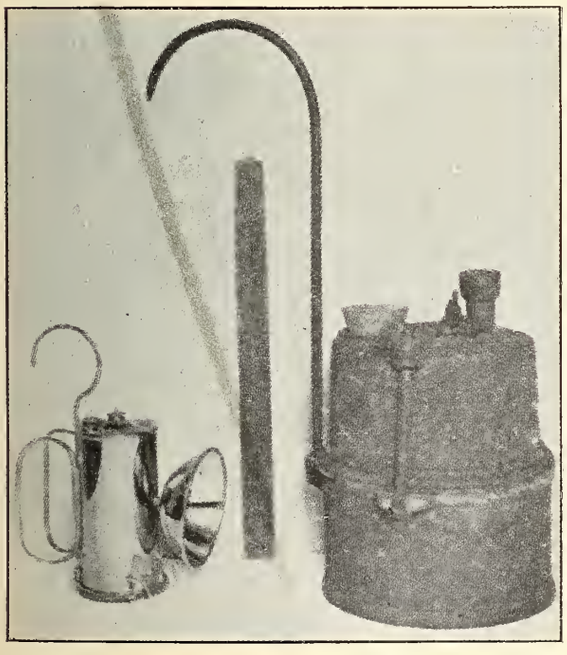
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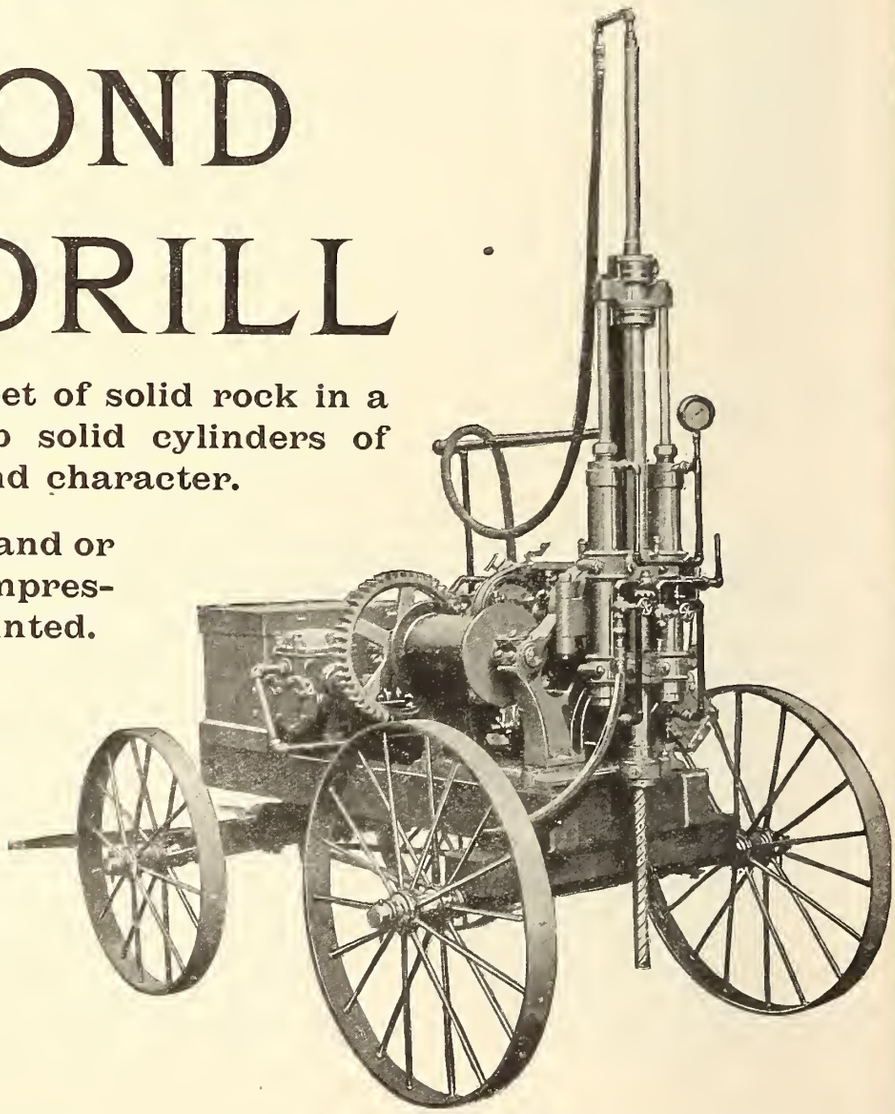
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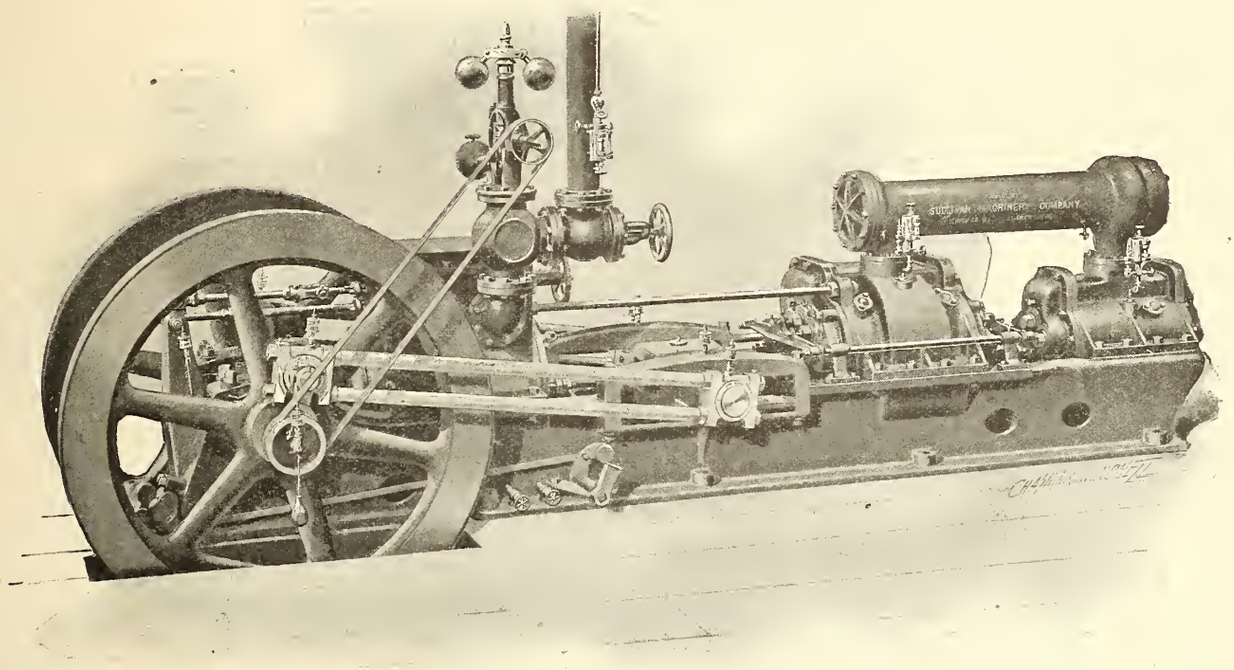
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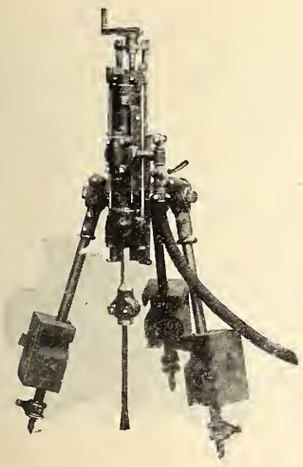
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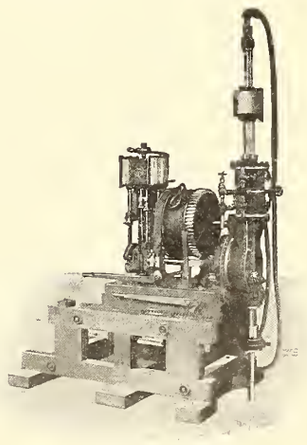


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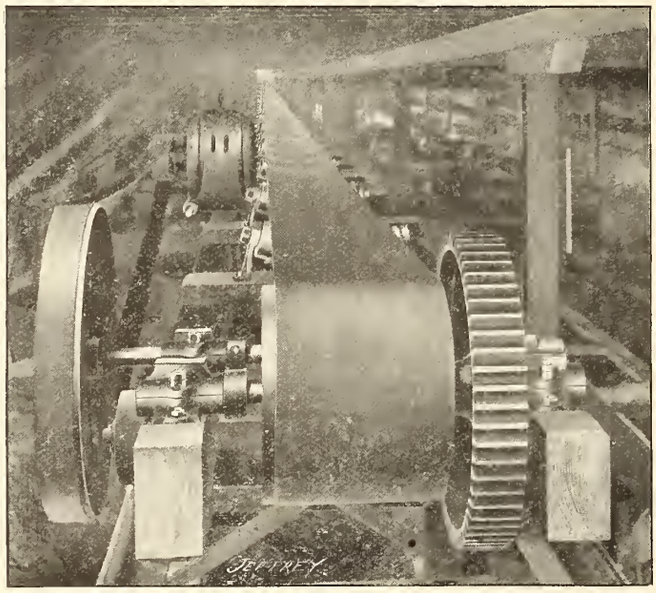
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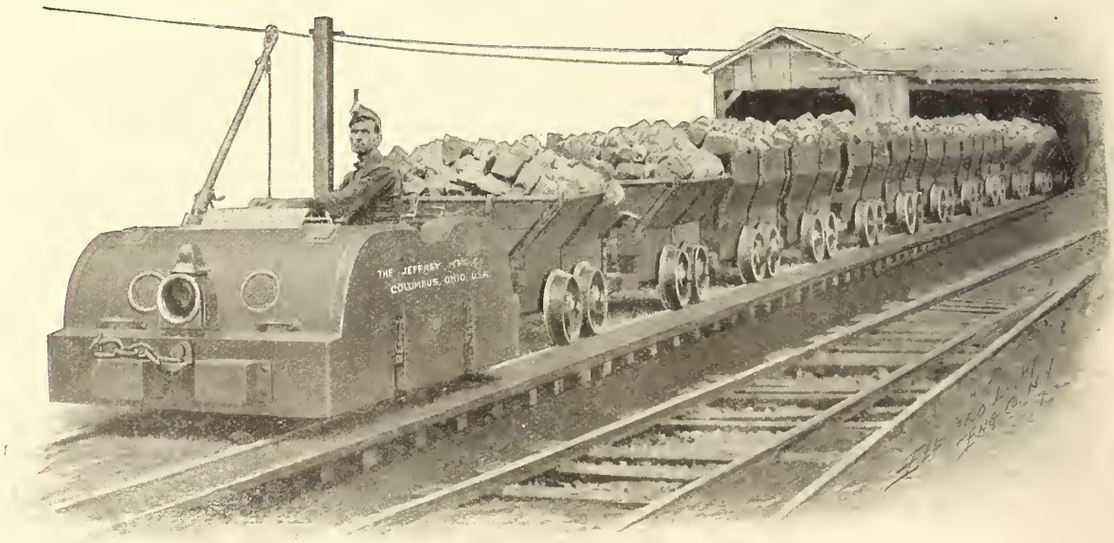
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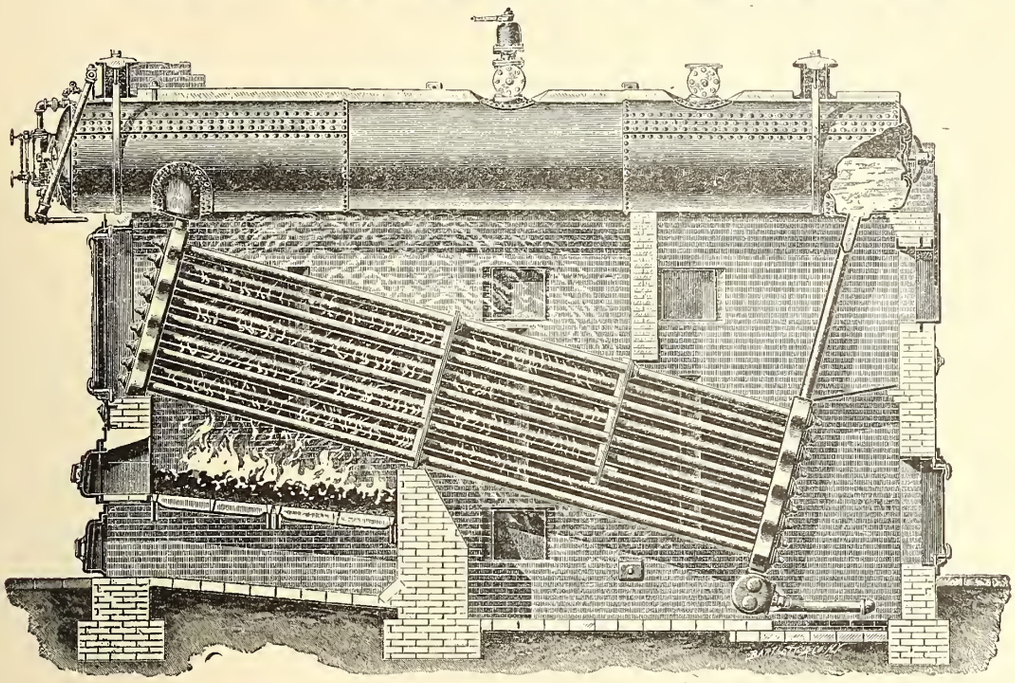
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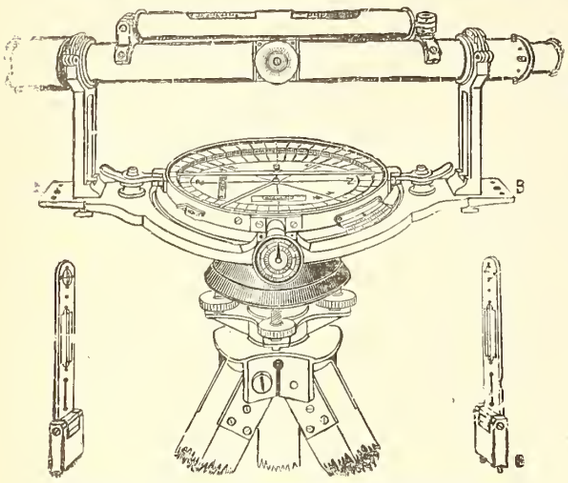
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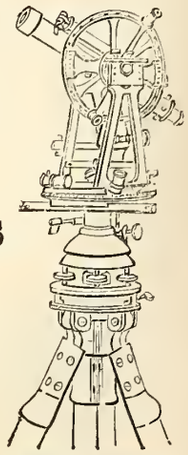
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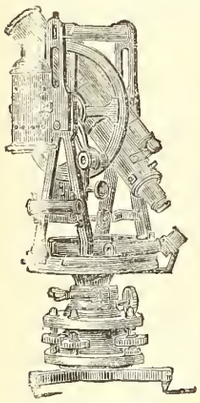
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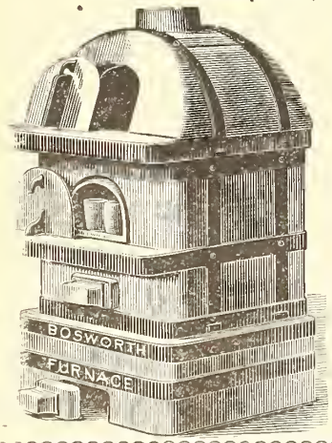
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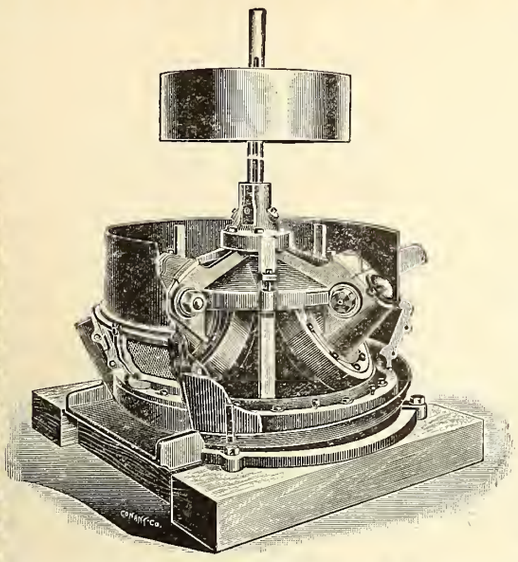
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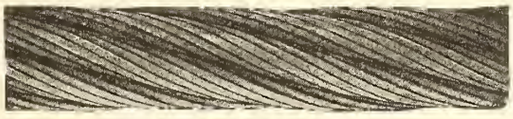
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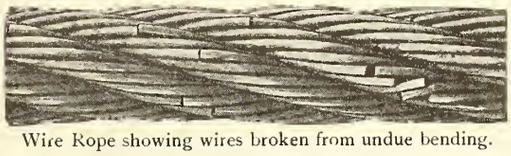
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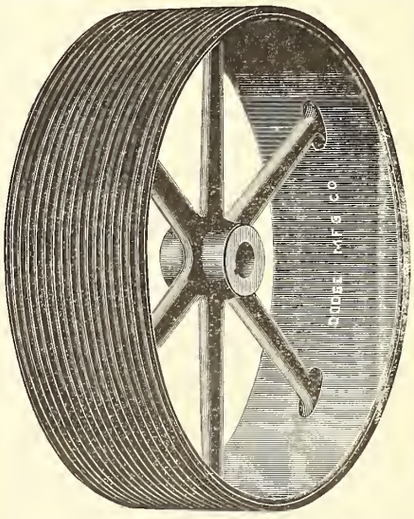
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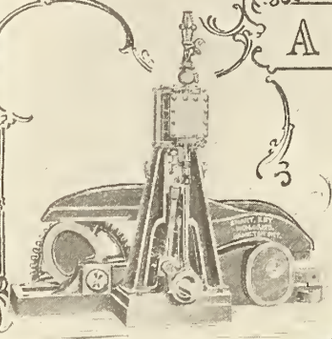
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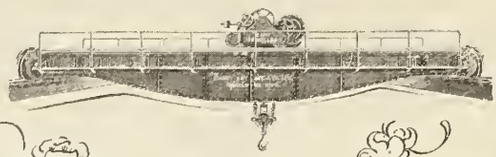


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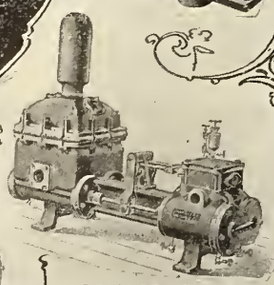
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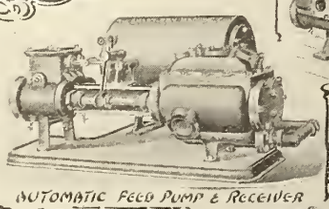


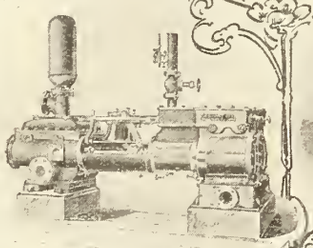

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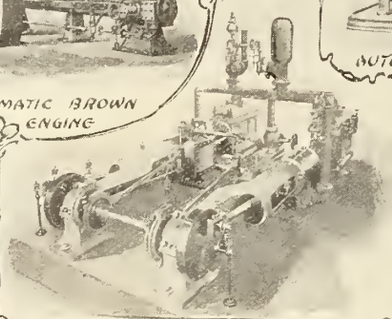


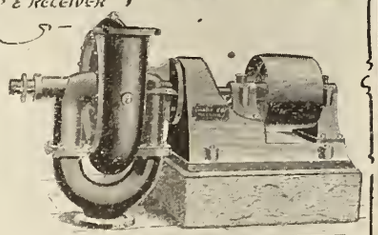


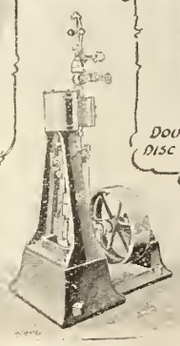

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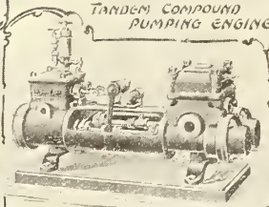


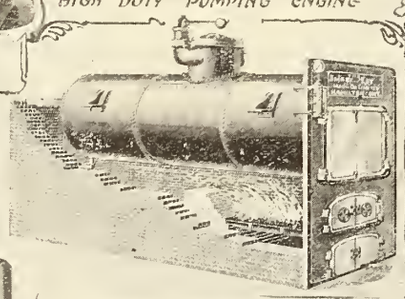

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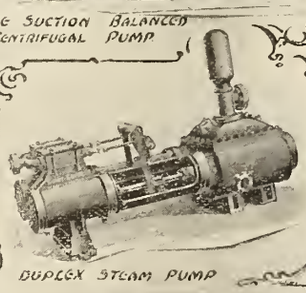

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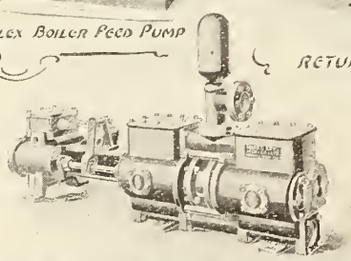
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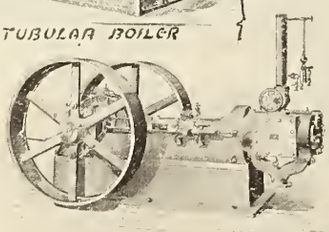


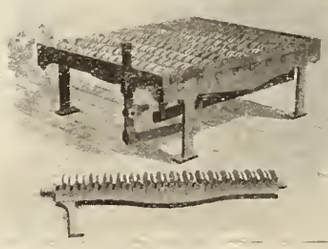

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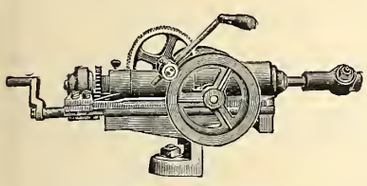
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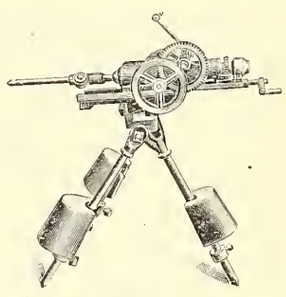
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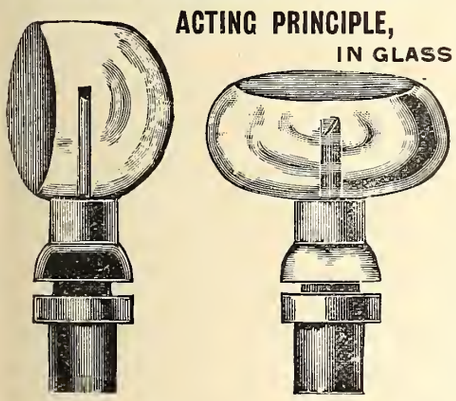


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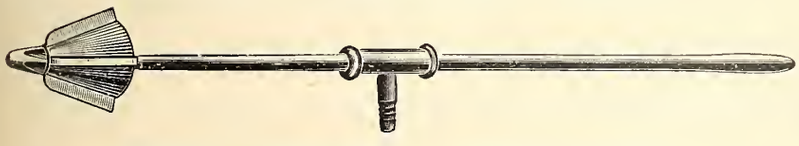
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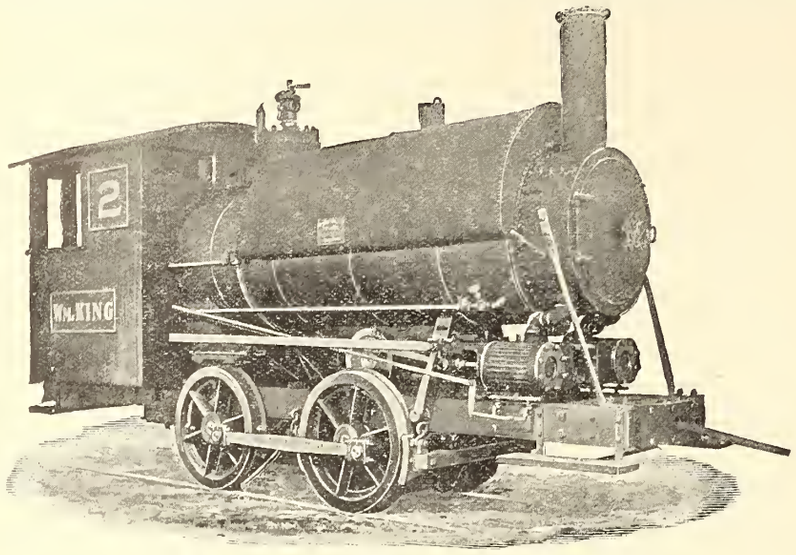
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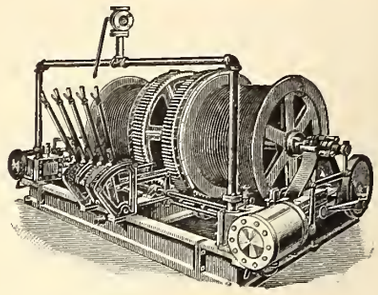
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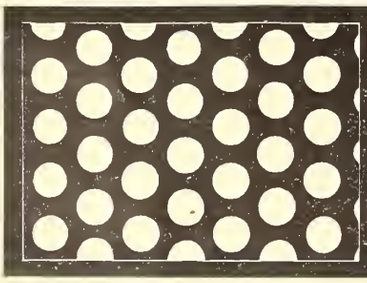
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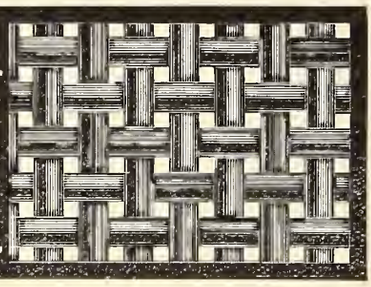
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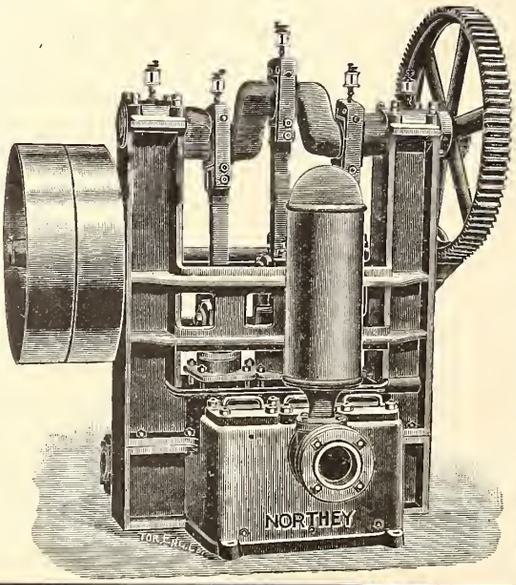
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VOL. XXI., No. 2. FEBRUARY, 1902. VOL. XXI., No. 2.

The Lead Problem in British Columbia

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No. I.

For a period of about nine months now, an Order-in-Council has been in existence which offers a bonus for five years on refined lead which is "the product from ores mined, smelted and refined in Canada;" this bonus is a decreasing one, but averages $3.00 per ton of refined lead produced, for the whole five years. In the closing days of last December the Canadian Smelting Works, through its general manager, announced that a small refinery of ten tons daily capacity would be erected at Trail, B.C., to be completed about May 1st; so that it is probable that within twelve months of the date of this Order-in-Council British Columbia will have a small refinery and will then attempt to work out the problem of a market.

Numerous articles have appeared in print, both east and west, bearing upon this problem, and although the non-technical man may have had his mind confused by the diversity of the views presented, yet all of these articles have tended to throw light upon what is vital to the life of the silver-lead industry of Canada. The relation of the cost of production to the price received for the product is stated by one writer as *the* difficulty; but it seems to the REVIEW that the real difficulty is to get a market for the products of the lead mining industry. There is no home metal market of sufficient size or importance to be of any great aid; our country produces almost every mineral product largely in excess of its needs, and pig iron, coal, copper, lead, precious metals, asbestos, graphite, mica and other minerals are obliged to seek a foreign market In the case of the lead industry and under the restrictions imposed by the Lead Trust of the United States, there is no market in that country, and lead bullion must go across the ocean, either to a European or an Oriental market. To reach either of these markets involves such heavy charges for transportation and insurance as to quite obscure from popular view, for the time, the local charges for smelting and freights. From recent information, directly received, the cost of land and ocean freight and of treatment in European markets, may be said to average *not less* than $30 per ton. Considering the Oriental market, there is no demand there for other than a special refined quality of lead suitable for the native to beat into the tea lead used in the tea industry of India, China and Japan. It is a matter of record, and of fact, that the large Australian corporation, the Broken Hills Proprietary Company, tried for three years before it succeeded in making a soft lead which suited the requirements of the oriental lead-beater It is equally of record that the Selby Smelting and Refining Company of San Francisco also took much time to make a product which was satisfactory, and that the market is now largely supplied (if not completely filled) by the production coming from these two large concerns and from England. The Canadian refiner seeking an oriental market has therefore no simple or easy task ahead of him, for, in addition to lengthy experience required to make the quality which the Eastern market requires, he would be handicapped by coming into direct competition with the well established product of the concerns already mentioned, and, unless a pooling arrangement could be effected, a war of prices would unquestionably ensue.

The Southern market, the United States, has been definitely closed by the action of the American Smelting and Refining Company, whose object unquestionably is to secure control of production so as to dictate the price of lead for the United States, and for the whole continent. This company will naturally restrict its production so as to enable it to keep control of the price of the metal, and a paragraph in the New York *Evening Post* of February 19th, 1902, announced that the Guggenheims had now secured control of the production of the principal producing mines in the United States.

Upon surveying the ground it is difficult to see how the erection of the refining plant at Trail will substantially alter the conditions which now prevail in British Columbia. As the entering point of a wedge, it may grow, in the course of time, to a factor able to afford a distinct relief to the industry, but it cannot for many months, and perhaps for years to come, afford any distinct relief to an industry which, although it is not yet paralyzed, has nevertheless suffered a very serious curtailment of its production and is in anything but a prosperous and progressive condition. It is not so very many years since the United States tariff was so arranged as to promote and favor the importation of lead ores which were required to smelt the excess of dry ores which the country was then producing, and, as a direct consequence, the importation of Mexican lead ores, and subsequently of Canadian lead ores, was enormously stimulated. Some five or six years ago the United States production of lead ore had grown so as to be in excess of the amount required to flux the dry ores, and the tariff was again increased, being doubled. The direct result was beneficial to the United States, as it kept the lead smelting and refining industries alive, and supplied them with the proper ores. Now that the raw material is offered in excess of what is required for home consumption that excess has had to be exported, and quite recently the monopolizing of the industry by the trust called "The American Smelting and Refining Company" has enabled the price of lead in the domestic markets to be kept steady, although prices in foreign markets have dropped tremendously. The apparent control by the Guggenheim corporation

(the trust) of the chief silver-lead producing districts in the United States, holds forth no hope of a future Southern market for British Columbia for some time to come.

Some writers have taken the point that when ores were scarce in the United States the difference in the tariff, between the importation of the *ore* and the *bullion*, constituted a bonus which that country paid to British Columbia for smelting and refining this ore, and the claim has been made that since that bonus has been removed the restriction against the production of bullion on the Canadian side has also been removed. The statement may be true, but it does not point out any market for British Columbia bullion without having to pay excessive charges, which really amount to a tariff against such exportation. Another claim has been made that it is possible to establish a lucrative business by manufacturing lead pipe, and the different oxides of lead (red and white) which go to the manufacture of lead paints, the grinding of these oxides, and the establishment of a Canadian brand of lead manufactures which would be profitable. We regret to say that the figures of the consumption of lead and lead manufactures in Canada as given in the Trade and Navigation Returns do not support those who hold this view. With an annual production of 60,000,000 pounds of lead, and a total home consumption of less than 25,000,000 pounds of lead, and all its manufactures, there remains a very large amount of unmanufactured lead which *must be sent to a foreign market* for sale.

The claim that the discrimination against British Columbia by the American Smelting and Refining Company provides an inducement for the establishment of the refining and manufacturing in Canada is a sophism, until the market for such refined and manufactured products is obtained. To say that the question of competing against the Trust is merely the three matters of "(1) owning the raw material, (2) being able to reach the market, and (3) being able to procure the capital necessary for the manufacture," is only to re-state the problem without giving any attempt at solution. The matter of owning the raw material is a *fact*, an axiom; the *crux* of the question is to get a *market*. A market once obtained, capital in abundance will readily be found without much seeking.

The complaint of lead mine owners that charges for freight and treatment rates are exorbitant, involves a statement and discussion beyond the limits of this article, but which the REVIEW promises to take up in a later issue.

Reduced Costs at the Le Roi.

Detailed figures of the results obtained at the Le Roi Mine during the month of November last were received too late for our January issue, but are republished herewith Only the operations for the month of November are included, but the figures must be most gratifying to the shareholders as showing a substantial reduction in costs, and as an intimation of a probable further reduction in the near future. As Mr. J. H. McKenzie, the new General Manager of the Le Roi Mining Company, Ltd, did not arrive in Rossland until November 26th, the report, in reality, shows the results of a month's active personal management of Mr. R. J. Frecheville, the Managing Director.

For the 30 days included in the report there were shipped to the Northport Smelter 14,088 tons, giving an average assay value of $11.28 per ton. This value is divided as follows:—Gold $7.09, silver $0.34, copper $3.85; as the price of copper is given at 15½ cents in the returns the average copper contents would be $1.24 per cent. 1,639 tons of low-grade ore were sent from the dump to the Trail smelter and realized a net sum of $11,634.07, or $7.00 per ton; the total income from all ore shipped was therefore $170,593.66. The total mine costs were $50,671.93; to mine equipment was charged the sum of $1,557.50, to surface improvements $787.40, to machinery $14.57, to handling ore from the dumps $409.79, or a total of $2,769.26, leaving $47,902.67 as the cost of mining 14,088 tons, an average cost of $3.40 per ton.

The total costs per ton therefore are.—

Mining	$3.40
Transportation	.75
Smelting	4.50
Marketing, etc	.75
Total	$9.40

This total cost of $9 40 per ton contrasts most favorably with the $10.72 per ton under the former management, and should convince the shareholders that Mr Frecheville's estimate of $9.00 per ton will be quickly realized. Since these lines were written a despatch has been printed in the daily press announcing that Mr. Whittaker Wright has again obtained control of the Le Roi Company. We discredit the report, and for the sake of the good name of British Columbia we hope we are right: the economies already introduced and the good showing made by Mr. Frecheville during the month of November have confirmed our belief that the *men* and not the *mines* have hitherto been the bugbear in Rossland.

Mining Progress in British Columbia.

With commendable promptitude Mr. W. F. Robertson, the Provincial Mineralogist for British Columbia sent to the Minister of Mines on the 15th of January his approximate estimate of the mineral productions for the year 1901. Mr. Robertson is to be congratulated on his recognition of the importance of publishing promptly, at the beginning of the year, figures which approximate, if they are not final, the production of the whole Province for the year just ended.

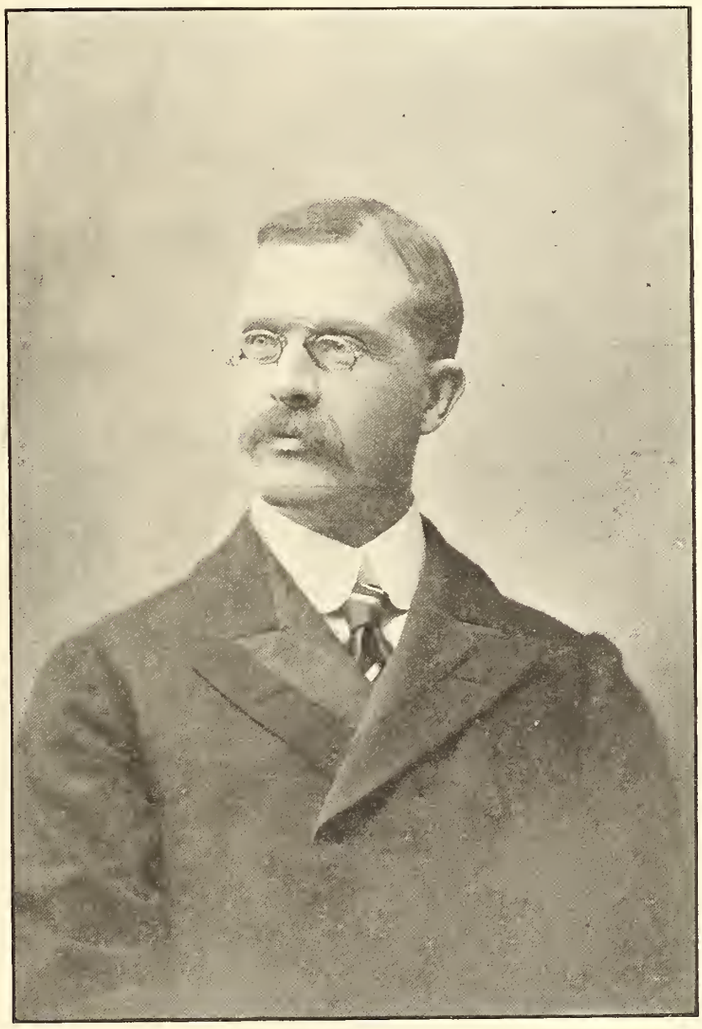
The astonishing and very welcome feature of the report is the increase in *values* produced, which amonted to over 25 per cent. (the estimated value of the total mineral production being $20,713,501, as against $16,344,741 for 1900), and also the increase in *quantities*, amounting to 63 per cent., or 354,727 tons.

The two districts to which this increase must be credited are Yale and West Kootenay, and of these Yale district (the "Boundary Creek country") must be given the palm, as it shows an increase of $3,328,-993, or 76 per cent. of the whole *nett* increase, amounting to a production two and one-third times greater than in 1900.

The increase in West Kootenay is found in the two divisions of Trail Creek and Nelson, in which the actual increase was $1,341,406, or 22 per cent. over 1900, and forming 30 per cent. of the total *nett* increase. The Coast districts practically were stationary, as they showed but 2 per cent. advance; Cariboo, Cassiar and Lillooet districts each showed a decrease.

In metals, placer gold decreased about 30 per cent., while lode gold increased in amount 36 per cent. The production of silver was increased as to *quantity* by 18 per cent., but as to *value* by only 13½ per cent. The production of copper increased 207 per cent. in quantity and 206 per cent. in value, while the only remaining important metal, lead, decreased 20 per cent. in amount and 23 per cent. in value.

The production of coal and coke was increased by only 9 per cent. in quantity and 11 per cent. in values, which we must confess is a surprise as smelting operations in the Boundary Creek country were expected to cause a very considerable increase in the quantity of Crow's Nest coke consumed; of coke (specifically) 1901 shows less than 50,000 tons more than 1900.



MR. J. B. TYRRELL, M.A., MINING ENGINEER,
Dawson, Y.T.

The general result is an agreeable surprise to most people who have not followed closely the development of the Province during the past 12 months, but it confirms the opinion expressed in these columns a short time ago that more legitimate work is doing to-day in British Columbia than ever, and probably is twice what was done during the period of inflation and boom times of 1890 to 1898. The REVIEW's congratulations to British Columbia!

Canadian Mining Institute.

The fourth Annual General Meeting of the members of this representative body of Canadian Mining Engineers and Mine Managers will be held, in the Club Room, Windsor Hotel, Montreal, on Tuesday, Wednesday, Thursday and Friday, 4th, 5th, 6th and 7th March next. Business sessions will be held on Tuesday and Thursday mornings at 10.30, and for the presentation and discussion of papers on the afternoon and evening of Tuesday and Wednesday, on Thursday afternoon and also, if necessary to close up business, on Friday evening. The annual dinner will be held in the Windsor on Thursday evening. In a programme of nearly forty papers we note the following:—

1. Copper Production in the Boundary District, B.C.
   By Dr. A. R. Ledoux, New York.
2. A Method of Mining Low Grade Ore in the Boundary District, B.C.
   By Frederic Keffer, M.E., Anaconda, B.C.
3. The Old and New Iron Industry Compared.
   By Mr. John Birkinbine, M.E., Philadelphia, Pa.
4. On the Occurrence and Treatment of Diamonds at the DeBeer's Mine.
   By L. J. Abrahams, F.G.S., Bruce Mines, Ont.
5. On the National Importance of Mining.
   By Mr. John E. Hardman, S.B., Montreal.
6. On Air Compressing.
   By Mr. W. L. Saunders, New York.
7. On Wire Ropes.
   By Mr. W. L. Hardie, M.E., Lethbridge, N.W.T.
8. On the Characteristics of the Atlin Gold Fields, B.C.
   By Mr. J. C. Gwillim, B.Sc., Nelson, B.C.
9. On the Hoisting and Hauling Plant at the LeRoi Mine.
   By Mr. Bernard MacDonald, M.E., Rossland, B.C.
10. The Leaching of Copper Ores by Sulphurous Acid at the Coconina Mill, Arizona.
    By Mr. E. P. Jennings, Salt Lake City, Utah.
11. Notes to Accompany Plan and Drawings of the Athabasca Mine, Toad Mountain, B.C.
    By E. Nelson Fell, A.R.S.M., Nelson, B.C.
12. Coarse Concentration in the Slocan District, B.C.
    By Mr. S. S. Fowler, S.B., M.E., Nelson, B.C.
13. On the Harris Air Lift for Raising Water at the Deloro Mine.
    By Mr. P. Kirkgaard, M.E., Deloro, Ont.
14. On Certain Fault Conditions in the Copper Mines at Butte.
    By Mr. Wm. Braden, M.E., New York.
15. Coal Mining in the North-West Territories and its Probable Future.
    By Mr. Frank B. Smith, M.E., Calgary, N.W.T.
16. On the Electro-Metallurgy of Copper and Nickel as Applied to Canadian Ores and Mattes.
    By Mr. Wm. Koehler, Cleveland, Ohio.
17. Eastern Ontario: A Region of Varied Mining Industries.
    By Prof. W. G. Miller, Kingston, Ont.
18. Notes on the Dry Ores of the Slocan District, B.C.
    By Mr. R. C. Campbell-Johnston, M.E., Nelson, B.C.
19. On the Origin and Distribution of Yukon Gold.
    By Mr. R. G. McConnell, Ottawa.
20. Notes on Gold Dredging. (Illustrated by lantern slides.)
    By Dr. J. Bonsall Porter, M.E., Montreal.
21. Notes on Gold Milling at Republic, Wash.
    By Mr. Fritz Cirkel, M.E., Montreal, Que.
22. On the Analysis of Insolubles.
    By Mr. Douglas Lay, A.R.S.M., Nelson, B.C.
23. On the Hematite Ores at Kitchener, B.C. (Illustrated by lantern slides.)
    By Mr. Wm. Blakemore, M.E., Montreal.
24. On the Iron Ore Deposits of Western Ontario.
    By Mr. F. Hille, M.E., Port Arthur, Ont.
25. Oil Furnaces for Milling and Assaying.
    By Mr. Charles Brent, M.E., Rat Portage, Ont.
26. Notes on the Limestone of the Philipsburg Railway and Quarry Co.
    By Mr. J. T. Donald, M.A., Montreal.
27. A Review of the Canadian Iron Industry in 1901.
    By Mr. George E. Drummond, Montreal.
28. Canadian Chromite.
    By Mr. Milton L. Hersey, Montreal.
29. Gold Dredging on the North Thompson River, B.C.
    By. Mr. F. Satchell Clarke, Vancouver, B.C.
30. The Ores and Minerals of Hastings County and District.
    By Mr. W. A. Hungerford, Deloro, Ont.
31. On the Economic Minerals of Vancouver Island, B.C.
    By Mr. W. F. Best, Victoria, B.C.
32. Notes on Silver Lead Mining at Huanchaca de Bolivia.
    By Mr. C. H. Macnutt, M.E., Pulacayo, Bolivia.
33. On Corundum Mining and Concentration in Ontario.
    By Mr. F. M. Fairlie, Kingston, Ont.
34. On the Copper Bearing Rocks of the Eastern Townships, Que.
    By John A. Dresser, M.A., Richmond, Que.
35. Power Drills.
    By Mr. C. C. Hansen, Montreal.
36. Mine Ventilation.
    By Mr. Charles Fergie, M.E., Westville.
37. Mine Pumping.
    By Mr. John P. Northey, Toronto, Ont.
38. Mine Haulage.
    By Mr. Wm. Blakemore, M.E., Montreal.

By special arrangement made with the Canadian Pacific, Grand Trunk, Intercolonial, Canada Atlantic, and Quebec Central Railways, mining men attending these meetings will be carried to Montreal and returned for a single fare on obtaining the usual form of Convention Certificate from the ticket agent when purchasing their ticket and on same being signed by the Secretary of the Institute. These meetings promise to be of an unusually interesting character, and the attendance of Canadian mining men will be large.

Crow's Nest Pass Coal Company.

The REVIEW acknowledges receipt of the following letter from the Solicitor of the Crow's Nest Pass Coal Company, Limited, complaining of certain paragraphs contained in a communication printed in the last issue of the REVIEW under title of "An Appeal to Cæsar."

Having no desire to be unfair, or to prejudice the interests of this corporation, we have pleasure in reproducing this document:—

The Publisher, &c.

Sir: - On behalf of the Crow's Nest Pass Coal Company, Limited, I give you notice in writing that they complain of the following statements contained in the issue of the CANADIAN MINING REVIEW published at Ottawa on the 31st day of January, 1902.

A. "And it can hardly be a pleasant reflection for loyal Canadians that a property which by common consent is one of the most prodigal gifts of nature, one which is absolutely unique in value and kind, should already have passed beyond the control of Canadians to whom it was originally entrusted, should have been officered and managed almost exclusively by Americans, who in several important respects, which need not here be dwelt upon, have begun to show their total disregard both for the sentiments and interests of Canadians."

B. "The second ground upon which our contemporaries base their appeal to Mr. Sifton is that actual discrimination against Canadian interests has already taken place."

C. "Further, there has been a constant discrimination against Canadians in respect of the price of coke if not of coal. Coke supplied to the Great Falls smelter has been furnished as low as $3.50 a ton on cars at Fernie."

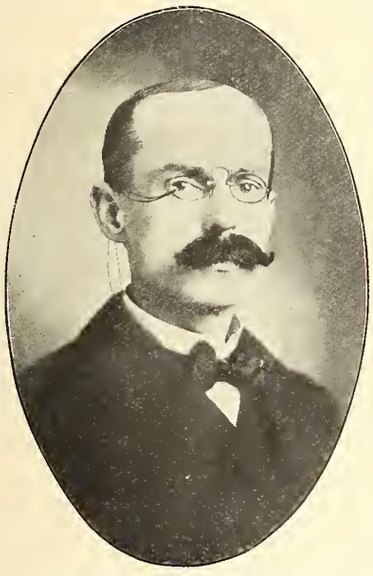
G. G. S. LINDSEY,
General Counsel, Crow's Nest Pass Coal Company, Ltd.

Dated Toronto, Feb. 14th A.D. 1902.

While giving space to this letter, we would take the opportunity of suggesting that Mr. Lindsey enlighten our readers upon the following questions arising out of the paragraphs noted in his complaint:—

While Mr. Hill may not at the moment hold a controlling interest in the stock of the Crow's Nest Pass Company, his investment in it is admitted to be a very large one, amounting, we understand, to something like $600,000—is it not a fact that his American connections and interests are of such vital importance to the success of the corporation that he cannot be regarded other than the predominating factor in the direction and control of its affairs? Is it not true, also, that since Mr. Hill's connection with the company an American consulting engineer, an American superintendent, Mr. Stockitt, and several American mine managers have replaced their predecessors, and that practically the whole office staff at Fernie, with the exception of an accountant, or head clerk, is American?

Incidentally we may remark here that there are two Stockitts. The elder, Mr. Louis Stockitt, has been for several years a mining engineer in the employ of Mr. Hill. He was manager of the Sand Coulee, and other mines, until a few years ago, when Mr. Burrill resigned the position of chief mining advisor to Mr. Hill and Mr. Louis Stockitt was then promoted to take his position. This is the gentleman who, it is said, supervises the mining operations of the Crow's Nest Pass Coal Co. He resides in the States but is represented on the spot



MR. THOMAS STOCKITT,
Manager, Crow's Nest Pass Coal Co., Fernie, B.C.

by his brother, Mr. Thomas Stockitt. To prove the absolute identity of interest between Mr. Hill and the coal company, it may be pointed out that these men superintended the railway construction in the Crow's Nest Pass on behalf of the Great Northern last year, while directing the management of the mines; and in one instance in particular, when the C. P. R. had applied for and secured an injunction to prevent the Great Northern from continuing to build a branch railway from the Crow's Nest line up Morrissey Creek, the only person who was authorized to accept service of this injunction was Mr. Thomas Stockitt, to whom the officers of the law were referred and who ultimately accepted it.

Mr. Lindsey might also be good enough to inform our readers if it is not a fact that while large shipments of coal and coke were being made last summer to the United States for the use, presumably, of competitive American smelters, Canadian smelters were short in their supplies, could not obtain coke from the company, and the situation became so acute that the Canadian Pacific Railway positively refused to supply cars for export until Canadian demands were supplied!

Finally, concerning paragraph *C*, we have been informed on no less an authority than a former manager of the company that, in the early part of 1899, Crow's Nest coke was sold at $3 50 at ovens to the Great Falls smelter. Does the Company deny this?

We shall be pleased to give prominent publication to Mr. Lindsey's refutation, on behalf of the Crow's Nest Pass Coal Co, of these points of interrogation.

A Method of Mining Low Grade Ores in the Boundary Creek District.

By Frederic Keffer, M.E., Anaconda, B.C.

It is usually the case in new districts presenting a variety of new conditions, that a good deal of preliminary work must be done to determine the best methods of mining and treating ores. This has been true in the Boundary District, the ores of which, as a rule, are of very low grade, occurring in deposits of great extent without well defined walls.

It is the purpose of this paper to describe the methods of mining at the Mother Lode mine in Deadwood Camp, near Greenwood, and the reasons which have led up to their adoption.

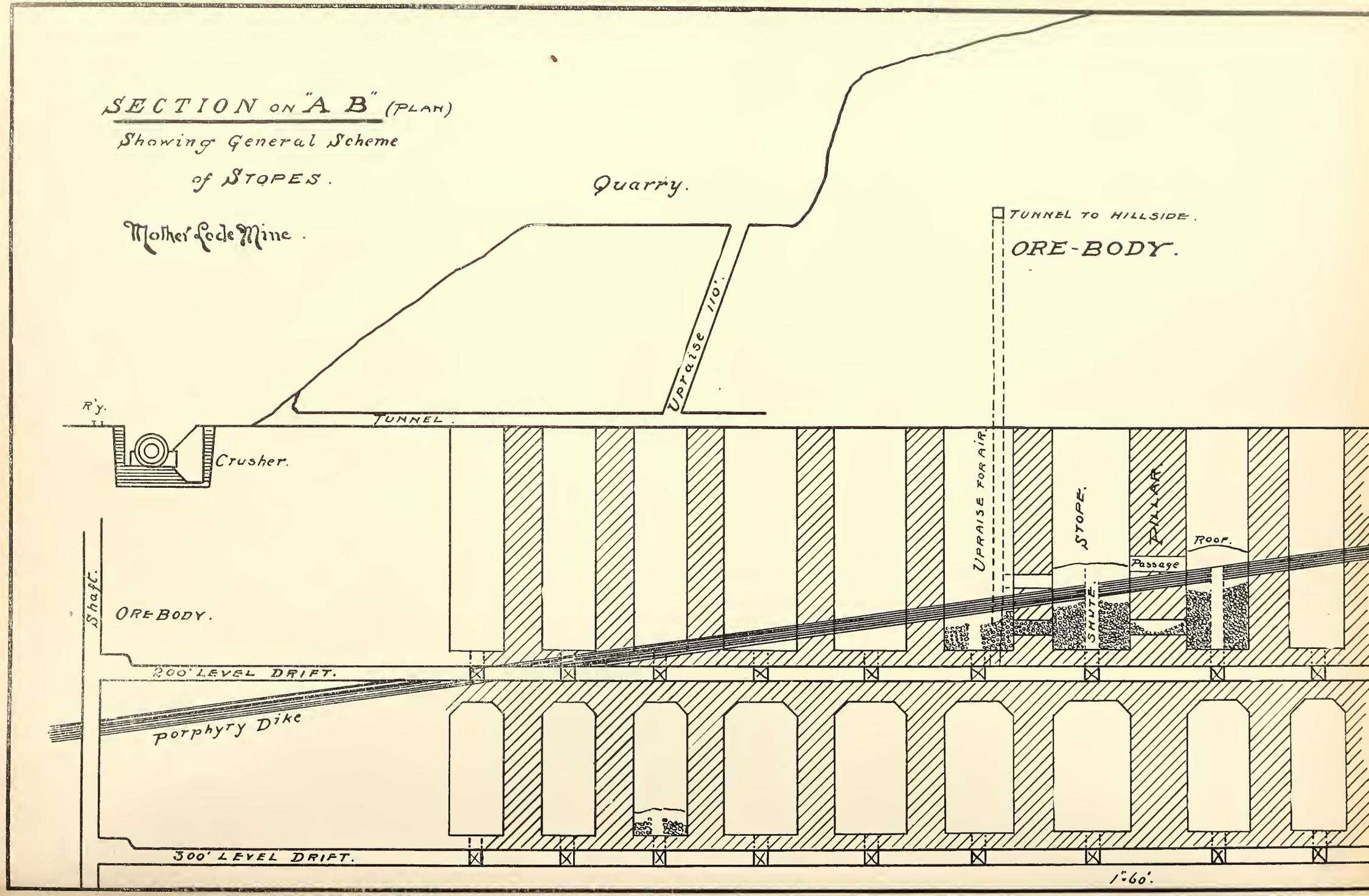
The ore deposit here outcrops at intervals for a distance of about 2,000 feet, the width in explored portion averaging perhaps 140 feet, although the absence of any defined walls prevents exact measures being given. The dip is about 70 degrees easterly, and pitch toward the south at an angle yet undetermined. Only the ground to the north of the shaft, which is located centrally, has been explored as yet. At the beginning of stoping operations, the ore body had been developed by a northerly drift from shaft on the 200 level, the drift extending to apparent end of ore. The deposit was crosscut at intervals of about 100 feet. Similar work was also done on 300 level. A winze to surface, about 500 feet north of shaft, afforded good ventilation.

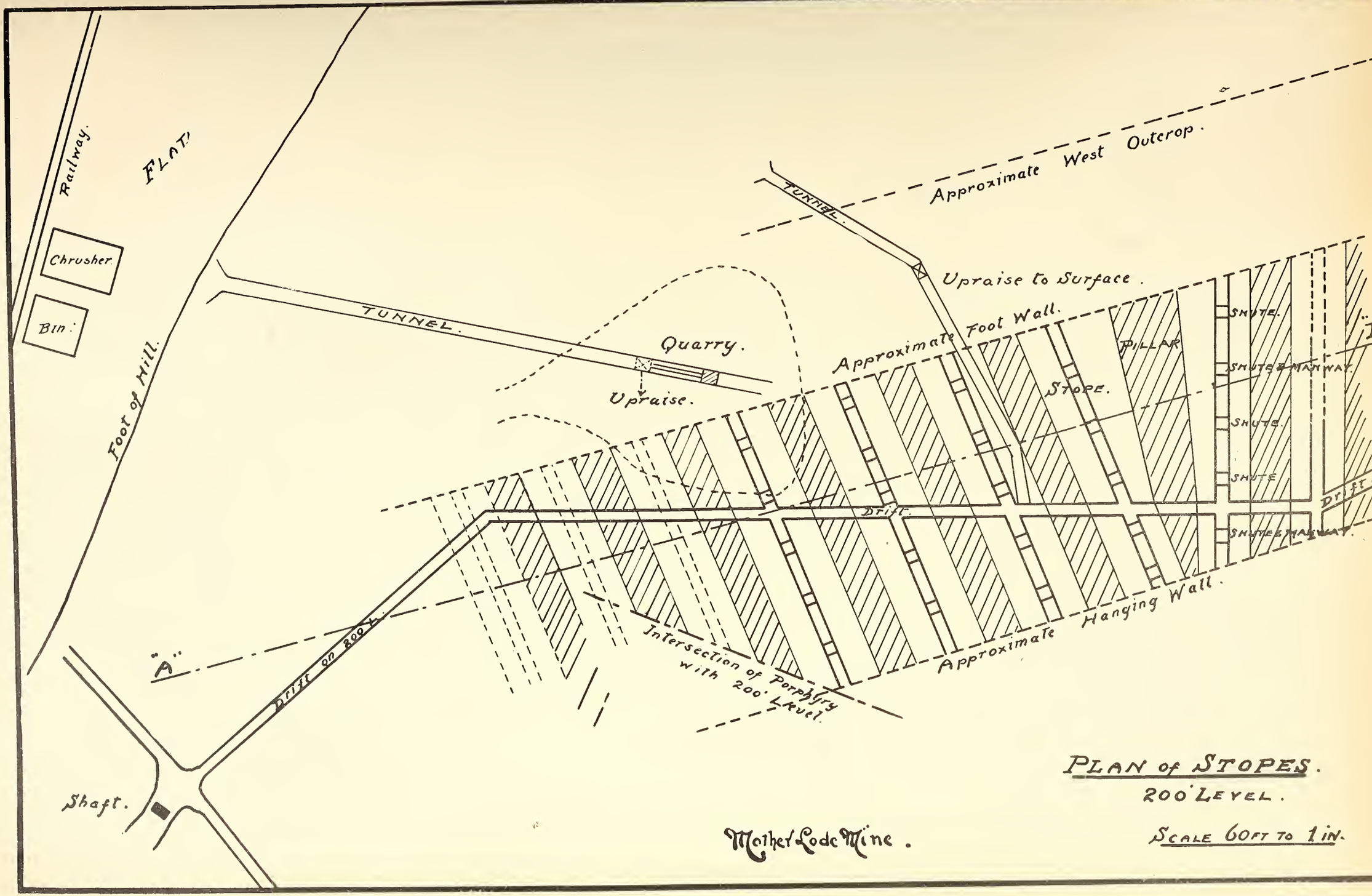
It was the original intention to sort all the ore from the mine, filling the stopes with the waste, and with other rock blasted from walls or elsewhere obtained. To this end a system of belt conveyors was arranged whereby the ore from shaft was dumped into a No. 5 Gates crusher, thence passing over a 3 foot wide picking belt to the ore bins. The waste was dropped into side pockets falling upon another belt system, whereby it was conveyed to a bin at top of winze, whence it was to be dropped into the stopes.

It may be said here that the term "waste" is, generally speaking, merely comparative, for the whole of the ore body (with exception noted below) contains copper, gold and silver in varying degree, and waste is merely rock with lesser quantities of these metals. The sorting and conveying belts worked to a nicety, but the smelter had been in operation but a short time when it became apparent that its capacity for these self-fluxing ores was much greater than had been thought possible, and consequently smelting costs were lower than had been figured. A direct result of this was that the definition of "waste" was altered, and its quantity greatly diminished. And further, that the cost of sorting out this diminished waste was approximately equal to the cost of smelting it; for even the poorest of the rock contains some values to offset in part the smelting charges. These conditions necessitated the abandonment of the filling plan for stopes. Also the sorting of ores was suspended, save for certain ores from 300 level, where the waste happens to be totally barren and easily sorted out.

The filling system having been dropped, it was then planned to timber the stopes in the ordinary fashion, but this plan was abandoned on account of high cost of timber compared with ore contents.

A third alternative was next adopted in one stope—that of timbering the whole of the floor of stope heavily, only the excess of ore from above being dropped through shutes conveniently placed. This plan


SECTION ON "A B" (PLAN)
Showing General Scheme
of STOPES.
Mother Lode Mine.
Quarry.
TUNNEL TO HILLSIDE.
ORE-BODY.
Upraise 110'.
R'y.
TUNNEL.
Crusher.
UPRAISE FOR AIR.
STOPE.
PILLAR.
ROOF.
Passage
SHUTE.
Shaft.
ORE-BODY.
200' LEVEL DRIFT.
Porphyry Dike
300' LEVEL DRIFT.
1"=60'.


Railway.
FLAT.
Chrusher
Bin.
Foot of Hill.
TUNNEL.
Quarry.
Upraise.
Approximate West Outcrop.
TUNNEL.
Upraise to Surface.
Approximate Foot Wall.
PILLAR
SHUTE.
SHUTE & MANWAY.
STOPE.
SHUTE.
SHUTE
Drift.
SHUTE & MANWAY.
Approximate Hanging Wall.
"A"
Drift on 200 L.
Intersection of Porphyry with 200' Level.
Shaft.
PLAN of STOPES.
200' LEVEL.
Mother Lode Mine.
SCALE 60FT TO 1 IN.

was going nicely until the roof of stope was some 20 feet over timbers, when a mass of ore became detached from roof, which mass weighed some hundreds of tons. Everything in its path was crushed and the stope wrecked. Luckily no one was hurt.

A further, and final plan, was then adopted. The ore body was divided into stopes 30 to 40 feet wide, the length of stopes being the distance across the ore body. The crosscuts already existing were used, and others cut where needed under the centre of each stope. From these crosscuts, upraises were made 30 feet apart. These were made 10 to 12 feet high, and were then connected by second and parallel crosscuts. From these latter crosscuts the stopes were opened out the proposed width, and then carried vertically upward, the short upraises being cribbed and furnished with gates for loading. Between the stopes, pillars 20 to 25 feet in thickness were left, these being frequently pierced to allow intercommunication and ventilation.

In the stope where the wreck occurred a very heavily timbered passage corresponding to a crosscut was built, shutes being placed at 30 ft. intervals.

The empty space was filled with porphyry blasted from a blanket dyke, which extends through all the ground yet explored. The accompanying plans and sections illustrate the general arrangement of the workings.

These stopes will be carried up to a point 160 feet above the 200 level, where they will meet with the surface workings to be described. After this occurs, the ore remaining in stopes above the porphyry will be sent through the shutes, and as much of the pillars removed at same time as safety may dictate.

The ore below porphyry may be removed at will, as this dyke is very thick and solid and will stand any pressure. In this method of working, nearly 50 per cent. of broken ore must be left in the stopes for a considerable period, but to offset this, the interest on capital so tied up is but a fraction of the cost of timbering these great stopes. Moreover, the system is as safe as mining can be made, the roof of stopes always being near the men, and there can be no wrecks occasioned by a cave. Further, there being no danger from timbers giving way, tremendous blasts can be employed and the ore broken down in great quantities at a time. One drill will frequently break down 75 to 80 tons in 24 hours.

On the 300 level, the pillars come directly below those on the 200, but in future levels the distance will be increased from 100 feet to nearly 175 to allow of less rock being left between levels, and less development having to be done.

SURFACE MINING.

To supplement the output from underground, a great amount of ore is now obtained by quarrying. In the hill which rises some 260 feet over surrounding flat, a quarry (or "Glory Hole" as it is locally styled) is in operation, this quarry being 110 feet above flat and 50 feet above collar of shaft. Ore is at present run down a gravity tram to Gates crusher, and thence over conveying belts to bins on the flat. This No. 5 crusher, experience has shown, to be far too small to admit of economical work, the ore having to be reduced to 10 inch size in order to pass into crusher. This reduction has mainly to be effected by "bulldozing" with high percent dynamite, the rock being too hard for hammer breaking. To obviate this difficulty, and to permit of cheaper handling, a tunnel has been driven into hill from level of flat. This connects by a 12 x 12 upraise with the quarry. In a pit on flat next the railway an immense Farrell crusher, with jaw opening 2 x 3 feet, is now being installed.

Ore will be dropped down the upraise, and there loaded into cars having a capacity of 4 tons. Trains of these will be drawn by mules to the crusher pit, where they will be dumped, by compressed air, over a grizzly leading to crusher. The screenings and crushed ore will be elevated to a bin beside the railway.

As quarrying proceeds, other raises will be made, and the level of quarry floor at the same time be lowered until the flat level is reached and the tops of stopes encountered, when these latter may be emptied. The present Gates crusher will take care of all ore from shaft as at present, its capacity being from 400 to 500 tons per 24 hours when fed with ore properly broken.

A photograph accompanying this paper shows the general arrangement of works, and the appearance of quarry when it was first begun.

Silver Lead Mining in Quebec.

The following, covering the operations of their property at Lake Temiscamingue, Que, is taken from the report of the British & Canadian Lead Co.:—"The first shipment of concentrates arrived in England on the 28th August, 1900, comprising 117 tons, and there was also shipped for testing purposes a parcel of crude ore of 13 tons; the total shipment, after deduction of smelting charges, realized £1,161 18s. 10d. The assay of the concentrates was 74.82% lead and 14.87 ozs. silver, and the average assay of the crude ore was 27.49% lead and 6.90 ozs. silver. The second shipment of concentrates of 27 tons 7 cwt. arrived on November 17th, 1900, and realized £278 16s. 1d., the assay being 65.50% lead, and silver 15 ozs. Acting in accordance with the recommendation of Mr. Ashworth, the directors arranged for a shipment of 62 tons of crude ore to be made for the purpose of testing the value and obtaining information as to its concentration. This ore, taken from the No. 3, or 200 feet level, was shipped to the Mechernich Mining Co., of Mechernich, Germany, and your Chairman and Secretary were present during the treatment of the ore at the works of that company in Germany. There was a considerable quantity of rock intermixed with the crude ore, but notwithstanding this, the actual result produced was 13.576 tons of lead and 302.8 ozs. of silver, which, after payment of expenses of trans-shipment to Mechernich and the cost of concentration, realized £138 1s. 10d. On the 4th January, 1901, a shipment of 57 tons (of 2,000 lbs. each) 1,490 lbs. of concentrates was made from the mine to the Balbach Smelting and Refining Company, of Newark, N.J. The assay of this shipment was 69.87% lead and 16.50 ozs. silver. Owing to the excessive charges of the American Smelting Company, and the large deductions made by them, the amount realized was only $1,915.54 (£392 10s. 7d.). It may be mentioned that at this time navigation had been closed, therefore shipments could not be made to Europe. The second shipment made in the present year, amounting to 107 tons 8 cwts., arrived in July last and realized the sum of £887 7s. 2d., subject to deduction of £195 freight from the mine to the smelting works, or say £1 16s. 6d. per ton including insurance (which figure practically agrees with the original estimate made by the vendors). The assay of this last shipment was 77.4% lead, 17 oz. 4 dwt. silver. There is a further shipment of 250 tons of concentrates about to be made to the mine, which, at the present market price, will realize some £1,600 after payment of freight and smelting charges"

Ymir.—Cable from the company's representative at Nelson, British Columbia:—"During last month 80 stamps ran 656 hours (27 days, 8 hrs.); estimated profit on operating is $9,472 (£1,953). The falling off is due to total amount crushed, 5,210 tons low grade ore. The grade of the ore shows considerable improvement during the present month drawn from the same stopes." (Office note—This explanation means that during January it was found impracticable to supply the mill with ore of the usual general average value owing to some temporary difficulty in getting the higher grade ore in the same stope.)

CANADA'S GREATEST GOLD FIELD—THE YUKON.



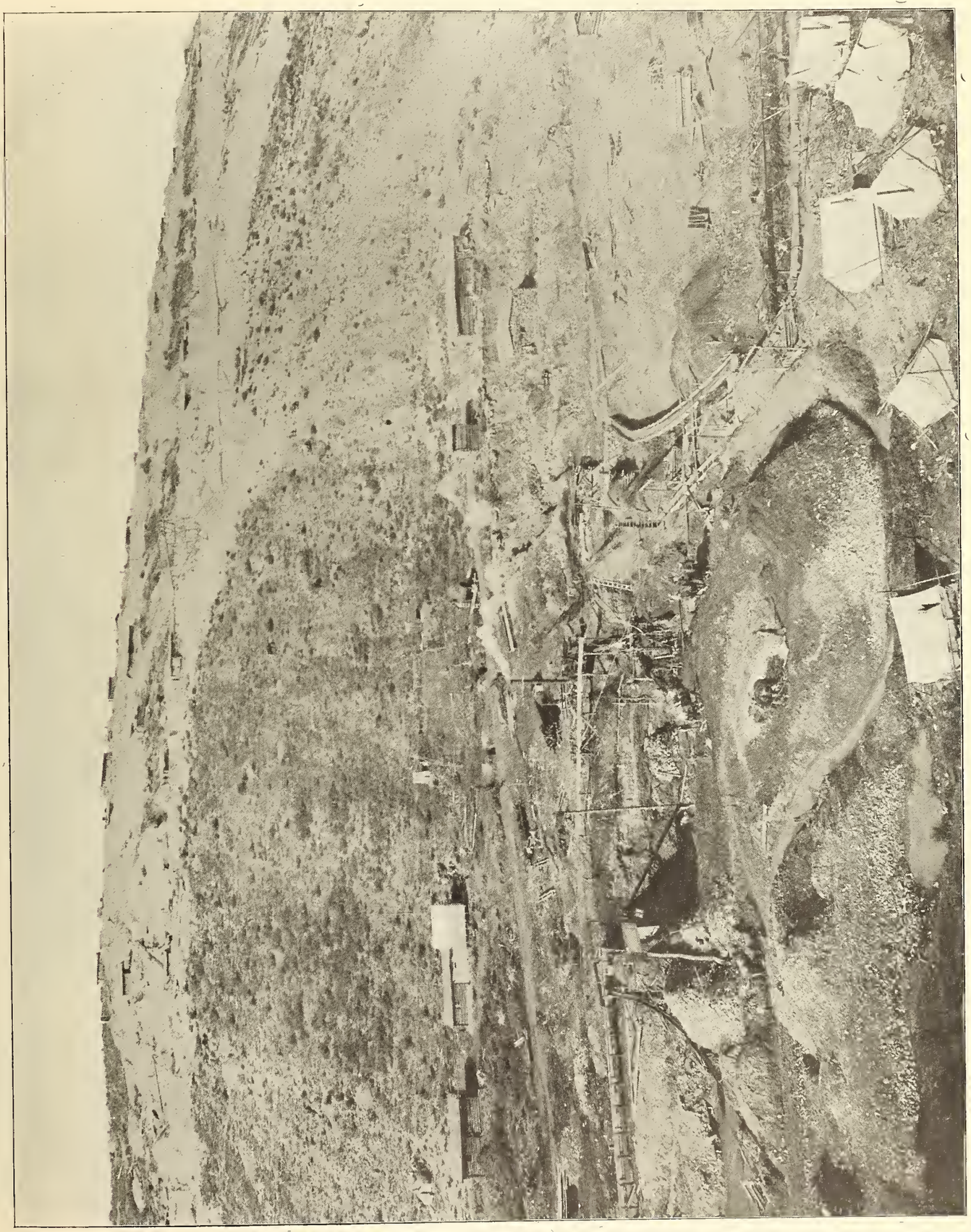
Gold Mining in the Yukon.—Looking down Bonanza Creek, Y.T.

CANADA'S GREATEST GOLD FIELD—THE YUKON.



Gold Mining in the Yukon.—The famous Chechaco Hill.

CANADA'S GREATEST GOLD FIELD—THE YUKON.



Gold Mining in the Yukon.—General View of Gold Hill.

COPPER MINING IN BRITISH COLUMBIA.



The Smelting Works of the B.C. Copper Company, near Greenwood, B.C.



This photo gives a general view of the handsome large works built by the Clergue Syndicate at Sault Ste. Marie, Ont. On the left hand is the Canadian Electro Chemical Company's Square Tower, then the two mechanical pulp mills, in front of which is the new office building. Further to the right, occupying the middle part of the picture is the machine shop, and in front of the large sulphite mill is the old Hudson Bay Blockhouse, now the residence of Mr. F. H. Clergue. To the left of the sulphite mill is the Laboratory and behind and further to the left is the Foundry. To the extreme right is the Roasting plant and the Sulphurous Acid plant.

IRON MINING IN ONTARIO.



The celebrated Helen Iron Mine, Boyer Lake, Michipicoten District, Ontario, worked by the Clergue Syndicate.















1.—137-ton Locomotive, No. 23, of the Algoma Central Railway.
2.—Ore Docks at Michipicoten Harbor, 12 miles from the Helen Mine.

3.—Chemical Pulp Mill.
4.—Mechanical Pulp Mill.
5.—Sulphurous Acid Building.

6.—Log Train on Trestle, Algoma Central Railway.
7.—Streets of new town of Tagona, showing cottages built for employees of the Steel Plant.

COPPER-NICKEL MINING IN ONTARIO.



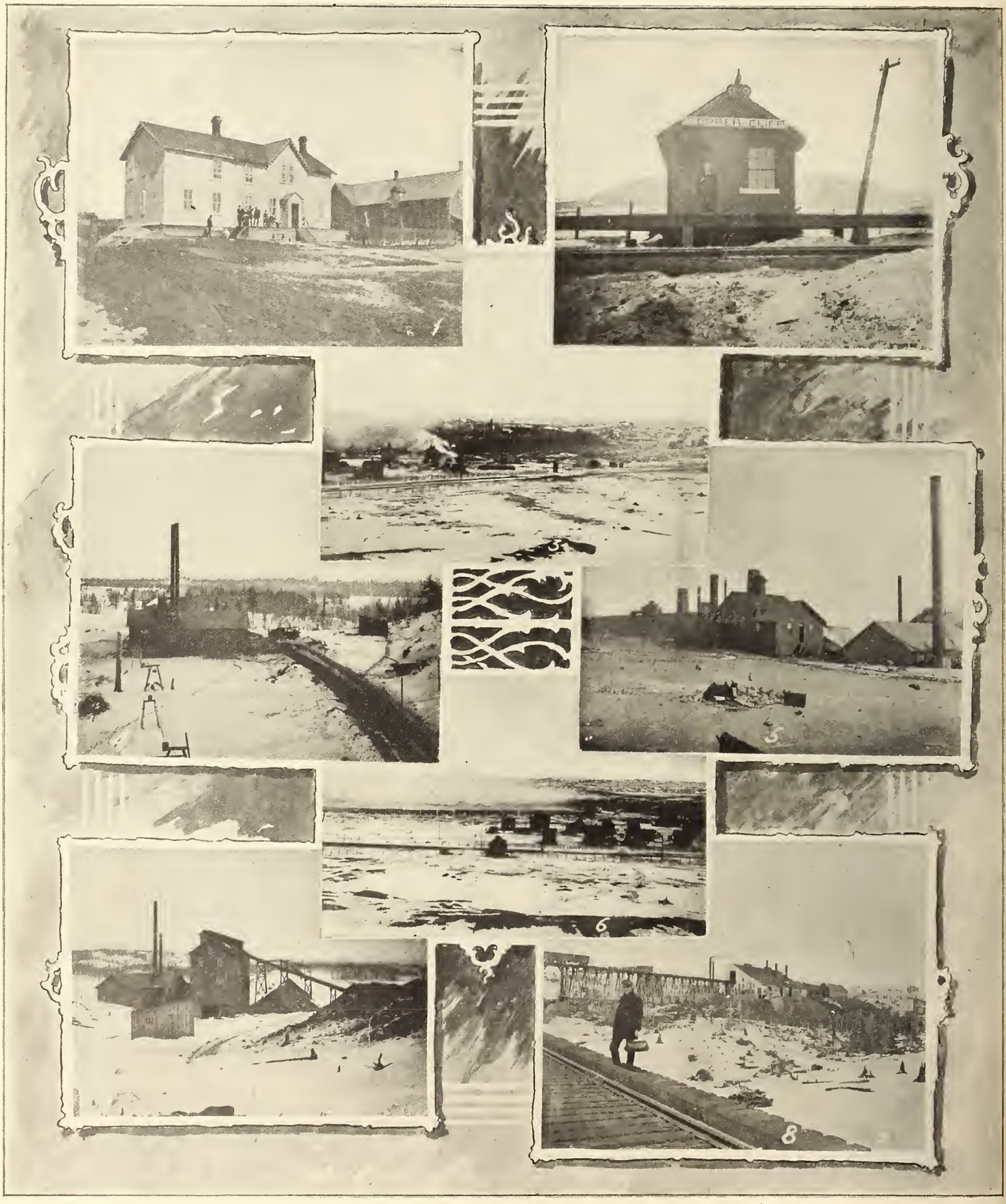
MINES AND WORKS OF THE CANADIAN COPPER CO. AT SUDBURY, ONT.

Matte Dump at Old Smelter.
No. 2 Mine.
Village of Copper Cliff.

No. 2 Smelter.
Train of Ore Cars running to Smelter.
No. 5 Mine and Rock House.

Interior Bessemer Plant.
No. 6 Mine.
Engine House No. 2 Mine.

COPPER-NICKEL MINING IN ONTARIO.



MINES AND WORKS OF THE CANADIAN COPPER CO. AT SUDBURY, ONT.

Club House at Copper Cliff.
Compressor No. 6 Mine.
No. 2 Shaft House.

Cinder Dump at Old Smelter.
Roast Heaps.

Copper Cliff Siding.
Old Smelting Works.
Trestle New Smelters.

A Few Notes Upon Gold Dredging.

By F. Satchell Clarke, Vancouver, B.C.

A great deal of attention has been paid of late years to gold dredging upon the rivers and placers of the Pacific Coast and North-West Territories down to Lower California, and, generally, a quantity of literature has been published by various papers and authors upon this subject, but, with one or two exceptions, little has been written by those having a direct and intimate knowledge of this form of mining.

This is really what is to be expected in any class of tentative work, for that is what it really has amounted to in British Columbia. Any work in which the experts are few will always cause to arise a host of empirics willing to learn at the expense of others.

Gold dredging in British Columbia instead of being the leading mining industry owing to its enormous extent of auriferous gravels has been marred by such empiricism and marked with many failures by reasons so palpable to the writer, that it has often occurred to him to ask with amazement "what kind of business men are these who invest their money without having a consulting engineer in dredging to advise them." A consulting engineer is always necessary with other mining, yet in this instance, in work that above all requires a specialist to advise, matters are left to run with the promoter, or quondam manager who may be appointed.

In New Zealand, the home of this industry, the work of recommending the claim and the actual details and construction of the dredge with its design is left to the consulting engineer, who is necessarily an expert in designing and actually operating gold dredges, and stands between the owner of the claim, or rather, to speak more correctly, the intending buyer of the claim and all other parties, and is merely paid a salary for a specified time, or a fee to cover the intending operations until the plant is completed.

This proceeding saves both the buyer getting a claim sold principally by the silver tongue of an interested party, and in another case building a faultily designed plant, foisted upon the first party by some of the would-be experts connected therewith.

The chief and prime cause of these failures which form the subject matter of this article has been the appointment of managers who, prior to holding their position, were without the slightest knowledge of this class of work, simply because in most cases he is, or becomes, a stockholder, or had possibly sold the claim to the investor, and according to the old and obsolete custom still retained in placer mining, "who so able to manage a claim as the large shareholder, as he is looking after his own interests as well as ours." Never was a greater fallacy more exemplified than in dredge mining history in British Columbia. A little desultory reading in the mining papers and reports gathered of what other dredges are doing and the manager blossoms forth into the dredge expert.

After the appointment follows the usual trip to New Zealand, California, or other places, to investigate the best type of dredge suitable for the claim. It appears to the writer equivalent to appointing a manager to a quartz mine and then sending him round to other mines to find out the best way to work the mine. He may, of course, return with the right ideas, but in the confusion of different opinions and dredges he has seen, it would be a matter of chance than otherwise, and his advice to his principals would be merely "the blind leading the blind." In some cases he returns with exaggerated ideas that he is getting the right machine and no other, and of course probably has been talked into it by the ready-tongued agent of some manufacturing company, or taken by the advertisements of some concern. Now, no matter how excellent the work of the manufacturing engineers is, he is unable to tell from his inexperience whether they are right or wrong in the details or general design. Then another class of managers are the persistent billet-hunters, who must be included among the causes of these failures, as these men are ready to take any job, provided there is a salary attached, no matter how ill their qualifications may fit in to the work.

Now, to turn to the different types of dredges used. There are many engineers and persons still in existence who cling persistently to the centrifugal pump as a means of dealing with auriferous gravels. This process has been exploded years ago in the great dredging centres. As a rule, with rare exceptions, gold gravels are composed of rough boulders averaging anywhere from 10 in. in diameter, and mixed up with a compound of sand, fine gravel and clay, forming what is known in mining parlance "a tight wash." It is almost impossible to work this by a pump, owing to the almost cemented qualities of this wash, and the throat of no pump has yet been made strong enough to stand the impact of the gravels, should the pump strike an occasional body of loose gravel, and then it is superfluous work as loose gravels seldom carrries any gold.

In spite of the repeated failures in New Zealand, California, the Snake River, and many other places, even to the Mawdach Gold Dredging Co., in gallant little Wales, where an attempt was made to dredge for gold at Barmouth; an enormous amount of money was wasted at Ruby Creek, upon the Fraser River, in trying to make a centrifugal pump dredge for gold. Interluding a little foreign news, after having seen the Barmouth gold dredging claims, I will undertake to say that with a properly constructed dredge there should have been a handsome investment for the stockholders. This may seem news to some, but there is quite a large extent of auriferous country in Wales.

Next to the centrifugal pump came a giant clam-shell dredge which was built some years ago at Lytton upon the Fraser River. This was the old mud dredger system applied by a pair of semi-circular steel plate self-shutting shells, very like its patronymic in appearance, and lowered to the bottom of the river by means of chains. On lowering these into the river, two almost insurmountable difficulties were met with; in the first instance, the strong current carried the clams under the bottom of the scow upon which the machinery was placed, and rendered it nearly impossible to bring it up full. The next trouble was that when the clams did bite into the gravels, a boulder or large stone would be held between the jaws, and by keeping them that distance apart would allow the whole of the finer gravels and gold to escape back into the river. This experiment cost the unfortunate shareholders $60,000 before knowing it was a failure.

After this came an attempt to exploit the gravels by means of a caisson or air-lock, by which men went down to the bottom of the river and by hand labour passed the gravel into an air-lock, and from there to the deck where it was treated by means of an ordinary rocker. Owing to the writer being brought into a controversy over this machine by the promoters, the project was killed by the caustic remarks made about the enormous cost in labour and steam to bring up a yard of gravel yielding probably 25 to 30 cents from the bed of the Fraser.

The writer was working a ladder dredge upon ground over which a pneumatic dredge had passed over and thoroughly prospected according to its ability and found too poor to work, which turned in to the shareholders for some years over 100% per annum clear of all working expenses.

Later upon the scene of dredging operations came the dipper dredge. This, as far as working a hole in the gravel, is moderately effective, and many of this type have been built and launched upon the the Fraser and the Sascatchewan rivers. Yet there are great stumbling blocks to the use of this type as a gold dredger. Chief among these are the want of mobility in handling it in a rapid river, the great cost in working them, (they require at the least 5 men per shift under favorable circumstances as against 2 men with the bucket and ladder type), the

intermittent discharge, the comparatively small cubic measurement of gravel actually worked in a week's run, and worse than all the inability to make a direct side cut across a river or bar, thereby enabling the ground to be worked upon a face and thus systematically clean up the bed-rock, or depth it is found necessary to go with the dredger. These points will always militate against it as a dividend-producing machine, except under very and exceptionably favorable circumstances.

All of this class of dredge which were built upon the Fraser and other places near have been started with a great flourish of trumpets (one was started last year) only to end disastrously. One manager of these dredges told the writer that his ground averaged 25 cents to the yard, and in the lower depths considerably more, yet he could not pay dividends owing to his intermittent digging. I understand that at 20 feet the gravel ran to as much as $3.00 per yard, but he was unable to keep his cut open long enough to take more than an occasional bite at it, for the reasons mentioned above.

The first plant to work the Fraser river in its rapid current and heavy gravels successfully was one of the bucket and ladder type, built in 1899 in England under the writer's supervision upon New Zealand plans, altered slightly to suit the conditions met with in this country.

This is known as the Cobbledick dredge, and is now under another name, "The Fraser River Dredging Co." This plant failed dismally the first year to pay anything, although quite an amount of gold was won, owing to the want of experience of the then manager, who was also a large stockholder—made by selling the investors the claim. He was a clever man with extravagant ideas, and threw the old company into debt. It was re-organized, and under the present management is paying moderately well, and the writer has no doubt but that when those at the head of affairs have gained more experience, the company will pay handsome dividends upon its present capital.

Some Eastern capital after seeing this plant work, decided to place a similar type, but of more powerful design, upon the North Thompson river 15 miles north of Kamloops, and the writer was instructed to prepare plans for the same.

The whole of this machinery was built in Canada by the Wm. Hamilton Manufacturing Co. of Peterborough, who to their credit made a vast improvement upon the New Zealand and British work.

This dredge is capable of lifting from a depth of 40 feet below water, washing, treating, and stacking the coarse stones and boulders to a height of 30 feet astern of the dredge, a guaranteed capacity of 2,000 cubic yards of gravel per day, and cutting its channel through a flat of 20 feet in height. The girder, or ladder as it is known, for carrying the continuous bucket chain is of the box type, built of ½ in. x 3 ft. 9 in. steel plate, tapering from the centre to a depth of 3 ft. at each end.

The lower, or digging end, carries a five faced cast steel tumbler which weighs over 6,000 lbs. (also cast in Canada). This ladder runs in a fore-and-aft line from a radius point 60 feet back from the forward end of the scow and extends forward and outside of the nose of the scow to a distance of 10 feet, this latter fact enables the dredge to cut its own way when necessary and keeps a channel open for the boat.

The bucket chain, or belt, consists of 35 heavy built up steel plate buckets, with their necessary connecting links, each having an approximate capacity or slightly less than 6 cubic feet. There are also at mid distances upon this belt two large powerful rock picks for tearing up bed-rock.

The belt travels along the ladder upon rollers fitted upon the ladder itself. The buckets have hard steel links rivetted to the bottoms, which are bushed with manganese steel bushes to prevent abrasion, these bushes take the manganese steel coupling pins which connects the buckets to the connecting links between each pair of buckets. Manganese is the only metal so far known to be able to stand the enormous wear and tear that takes place in the couplings of the buckets. At the mouth of each bucket there is rivetted a heavy steel reinforcement or cutting lip, which is detachable and renewable when worn out, thus retaining the life of the bucket.

The upper tumbler, which is the driving sprocket, is square and also is a steel casting; this is driven by a heavy, half-shrouded, square-geared wheel of 4 in. pitch keyed upon the tumbler shaft, and then by means of pinion gear and belting from the main engine. The speed of the top tumbler is 6½ revolutions per minute, which gives a bucket speed of 13 per minute, or a theoretical delivery of 172 yards of gravel per hour. In practice it is found best to deliver about 120 yards per hour to enable the tables to clear themselves.

The gear is driven by a 22 inch belt from a tandem compound surface condensing engine 10 in. and 20 in. cylinders by 16 in. stroke, running 150 revolutions per minute.

The gravel drops into a heavy, steel-lined shoot, and falls by gravitation into the revolving screen 5 feet in diameter by 24 long, and perforated with graduated holes from 5/16 in. to 7/16 in. At the upper end of the screen is rivetted a steel gear for driving it the necessary revolutions, and this in turn is driven by a steel pinion keyed upon an intermediate shaft running from the main gear shafting. The screen is held in position by 4 rollers 24 in in diameter, which revolve against a steel wearing band rivetted round the screen.

After the gravel has been sifted through this screen, the refuse is delivered into the stacker buckets by gravitation, and is conveyed by the stacker to the distance of 20 feet astern of the dredge and clear of any trouble the plant may experience by sitting upon its tailings.

The length of this stacker is 50 feet, and as it is little more than an ordinary elevator made much stronger for the large stones, etc., there need be no description given.

The water for washing the gravel, both in the screen and on the tables, is supplied by a 12 in. centrifugal pump, driven by a belt direct from the compound engine, and throws a body of water at the rate of 2,600 gals. per minute through the surface condenser, which has the effect of slightly warming the water to about 45°, thereby preventing it from freezing upon the tables in cold weather, thence through a perforated pipe leading down the whole length of the screen. The water and fine gravel carrying the gold then falls through the screen into a cast iron distributing box with shut-off gates each side, and through these gates evenly distributed to the tables set each side of the screen and at right angles to its length.

The tables for catching the gold are arranged in steps or drops similar to the deposition of a battery table, towards the sides of the pontoons, and the dirt is carried thence astern by a common launder. These tables have a width equal to the perforations of the screen, in this particular case 19 feet wide by 19 feet long, each respective table making a total superficial area of 361 feet exclusive of the launders and other catch-alls.

They are of wood, and in operation are first covered by calico, then cocoa-nut matting, overlain by expanded metal. This latter is found by long experience to be unexcelled for catching fine gold, in fact the percentage of gold which is lost upon dredges equipped in this way is very small.

That these tables are capable of saving gold extremely fine has been shewn by accurate measurements taken by trial from dredges actually in operation, by Mr. J. B. Jacquet, Government Geologist to New South Wales. A sample of gold from similar tables was weighed, and found to be about two grains in weight, which had been sifted through a sieve of 3,600 holes to the inch, was again sifted through one of 4,900 holes, and the gold which passed through sorted under a powerful lens. One hundred of the smallest of these pieces were thus selected and examined under a microscope. Measured with a micrometer their dimensions in fractions varied between 0.009 x 0.006 and

0.003 x 0.002, the mean of twenty measurements being 0.0065 x 0.0042, The hundred particles were then carefully weighed, and found to have a mass of 0.097 of a grain. The mean weight of the pieces was therefore 0.00097, or a little under one-thousandth of a grain. Several experiments also gave similar results.

As the life and working capabilities of a gold dredger depends upon the ease and rapidity with which it can be handled, especially in a rapid current, a careful design was shewn in the manœuvering winch. This is of most powerful design and construction, consisting of six barrels, self-contained within one frame. The first barrel is a double-geared drum to carry the 1,500 feet of 1¼ in. steel cable for the headline, which keeps the dredge up to her position in the face of dirt which it is working. The second drum carries the ladder hoisting line, and lifts or lowers the buckets into the gravel, being used extensively by the winch operator. The other four drums are in pairs, and are used for bow and stern lines respectively. The whole are driven by a pair of vertical 8 x 10 engines with reversing gear, whose main shaft is coupled direct upon a 6 in. worm shaft running the whole length of the frame carrying the drums. The worm shaft has three Hindley patent worms cut out of the solid shaft opposite each pair of barrels, and these worms revolve a 48 in. tangent wheel keyed upon the shaft of the drums. Each drum has patent friction clutches with powerful brakes attached also, and is therefore controlled independently of the others by the single operating winchman working a set of levers in a quadrant by the side of the frame.

The hull of this dredge is built of fir, and the frame is strengthened by heavy 10 in. x 16 in. chime logs running fore and aft, and braced by a simi-Howe truss of 6 in. x 8 in. timbers. The planking is 3 in. x 12 in., 4 in. x 12 in., and 6 in. x 12 in. The framing for carrying the top tumbler and gearing is brought up to a height of 40 feet above deck, and forms a main hogmast to both hold up the stacker and prevent the hogging of the pontoons, a frequent source of trouble with ladder dredges.

The total weight of the ladder, buckets, tumblers, and links is 43 tons, whilst the total weight of machinery is 150 tons.

After this description it would not be amiss to follow up a little of her career.

The plant worked well, but, alas! in this case, it was not the management that was in fault, as latterly they had a first class dredge operator from the Snake River, but the paucity of the claim in gold. As far as the writer's knowledge goes, the claim was bought principally upon the reports made by the sellers, and whether these were good or bad is not within the writer's province to discuss. It suffices to say that beyond a thin layer of sand and gravel of about an inch in depth upon the surface, no gold was found below that, neither disseminated through the gravel underneath this layer nor upon the clay bottom met with at a depth of from 15 to 20 feet. A further fact was brought to light during the operations of this dredger, viz.: that there was, with a few exceptions, no gravel met with in the middle of the river, nothing but a bare clay bottom into which the dredger dug for a depth of 8 feet to see if there was gravel underneath this strata.

Yet, showing how a dredger may fail with a fortune in sight, within a few miles was a mass of gravel which certainly carried a minimum of 25 cents per cubic yard, and the working expenses under careful management should not amount to over 3 cents per cubic yard. However, so disgusted were the owners with the financial results that as soon as winter came on they shut down without a further effort to look elsewhere.

As would be natural in this instance, the claim sellers around blamed everything and everybody except the paucity of gold in the claim. One quondam claim seller and expert went so far as to state that a large quantity of "invisible gold"! was being lost in the tailings. Another, after showing all and sundry visitors (before the dredge commenced operations) the brilliant showing their was upon the surface, stated all that was necessary to make the claim a success was a cyanide plant (!) to treat the gravel and black sands.

It shows how careful one should be in investigating the values of a claim, and not to rely upon the general remarks of those particularly interested.

As a rule, with rare exceptions, one certain sign of good payable dredging ground is the immediate vicinity of sluicing or rocking operations other dredging conditions being present. This, at any rate, determines the fact that payable gold is near, and there is a strong probability that a proposition may be looked into for dredging.

Upon the North Thompson River these operations were conspicuous by their absence. Upon the upper reaches of this river called the Clearwater, I understand there are claims worth looking into, and as to the Lower and South Thompsons no person can dispute their richness, but the gold seems to have been cut out from this river by the dividing range. As a matter of fact, there is no class of mining so profitable and so certain of financial results as gold dredging, provided the conditions given of gold present, workable ground and a good machine. These points can only be determined by the expert, and not by the average engineer, as is generally imagined. The business then really comes within the realm of an industrial proposition, producing large dividends for many years, being merely a question of value of ground in gold, with a constant factor of cost in production. The average figure for handling gravels with a bucket and ladder dredge should not at the outside limit exceed 3½ cents per cubic yard, including labor, fuel, etc.

The writer some years ago dredged gold gravels for over twelve months at the rate of 2 cents per yard.

Given then the actual value of gravels by expert prospecting and drill holes in many number, it becomes merely the everyday industry of machine mining.

New Zealand has been quoted and referred to so often that one is almost afraid to mention that country in connection with dredging, but the Government returns of gold won and dividends paid by the whole of the dredges working there show an average of 30% profit. Some, in fact, of their dredges produce something like 600% per annum upon their capital. Members can judge what this means to the investor.

LeRoi No. II.—The Reports and Accounts submitted at the annual meeting of the LeRoi No. 2 Ltd., held in London on the 9th of January, have been received and call for little extended notice. The dividend, paid in June, 1901, does not appear to have been earned, and from the papers presented and the discussion at the meeting it would appear that the junior company (LeRoi No. 2) is disposed to lay all the blame coming to it on the shoulders of the LeRoi Company. Our readers in B.C. will know how much (or how little) credence to give to the chairman's statement that even at the present reduced price of copper the "Josie" and "No. 1" mines can pay "handsome dividends."

Velvet Rossland Mine.—The directors announce an issue of 199,986 £1 shares credited with 17s. 6d. paid, and seven shares with nothing credited thereon.

Hall Mining and Smelting.—The mine manager cables, under date of 1st February, as follows:—"Output of smelting ore for January, 1,224 tons; average assay 14 oz. 10 dwts. silver per ton, and 4 per cent. copper. No ore sold to smelter during January. New ore shoot No. 6 level east, south vein, winze, 2 ft. 6 in. in width; grade of ore is very good; the face improves as we go on."

Tilt Cove Copper.—The accounts dated 20th December show that the mines made a gross profit of £60,591 3s. 4d. leaving, after charging the account with interest and discount, payable to the Cape Copper Co., the rent representing the interest on the Company's debentures, prospecting costs, management expenses, etc., a net profit of £47,908 11s. 0d.

GOVERNMENT AID TO MINING.

Discussion Communicated in Advance of the Meetings of The Canadian Mining Institute.

MR. C. A. MEISSNER, Sydney, C.B.

The subject of Government Aid to Mining is one well deserving careful attention from the members of the Institute. It is one that has distinctly two sides, which need careful consideration of both their merits and demerits. To a certain extent, the whole system of bounties and Government action is involved in this discussion. On the one hand, opponents of the system claim that in principle it is wrong; that it saps the energy of the people in making them less self-dependent; that it is likely to cause an influx of foreign capital under unhealthy conditions, not because of natural resources and advantages, but for the purpose of taking advantage of such bounties or aid offered, and thus get what the opponents call a fictitious value out of the products, instead of a purely legitimate one obtained by the actual worth of the raw material or manufactured articles, and that in the course of time these will likely stand dependable on this outside aid, instead of strictly on their own merits. On the other hand, it is stated by those favoring reasonable Government aid and bounties, that while, theoretically, these objections have perhaps some basis of truth, yet practically they are entirely dependent on the actual existent conditions, and must be studied and carried out with these actual conditions in view.

Where a country is well populated, or the growth of population is noticeably rapid and steady from year to year, where the mineral resources are by nature good and inviting, and where distances from point of production to market, from raw material to finished product, are not too great, and where the home general market is large and active, or a foreign market is easily accessible, and distances to that market not too great, then it is quite possible that too much dependence on Government bounties and aid is a weakening factor, and likely to make the people neglectful in taking initiative, and create a tendency to look to the Government, making the latter more paternal than is generally good for the nation. The same may be said of the last objection, *i.e.*, the entry of foreign, or even domestic capital for the purpose of taking fictitious profits out of the producing power of the land, which, having to be paid by taxation of the inhabitants, are likely to drain the country without adequate return to it as a whole, or only to isolated sections.

In taking up this whole question, therefore, it is necessary to carefully keep a wise middle path, which avoids too great paternalism, and yet gives such encouragement that any natural resources which are not surrounded by great advantages for development, should be made available in such a way as to prove of real and substantial value to the people and to their Government which represents them.

It appears to me that in Canada we have conditions which are of such a nature as to distinctly call for some such Government aid, judiciously applied to the development of its resources, outside of that which private capital, whether individual or corporate, can give to it, even if, apparently, it draws by taxation from sections that are not directly benefited by such development. The consideration is simply one of the greatest good to the greatest number of people, and by doing this you have solved the problem for a self-governing nation. You can never hope to satisfy everybody, and frequently the individual is not in position to be able to judge for himself what really is best for him as a unit of the whole nation. If such Government action is of ultimate benefit to the whole nation, then sooner or later, each individual unit is bound to derive some small part of that benefit.

Taking Canadian conditions, therefore, as they are, considering the natural resources, the vast area, the scattered and frequently thin population, especially in districts not having the best agricultural conditions, or not having good or easy transportation facilities, too far apart to be in close touch with each other, or to the capital-furnishing world, then it does seem that those interested in industrial development are warranted in going to the Government and saying,—"We are unable to develop our country as we would. We lack the money, the knowledge and the facilities for placing our resources before the world; we lack transportation; we are practically isolated; we do not, as a fact, know what we have, and we cannot develop what we have, so as to show and convince the outside world, or the capitalists at our centres, that what we have is good and worthy of their attention. Come to our aid, therefore. We will do what we can, and you may apply your resources as a government, and your facilities to get expert knowledge, and put us on a record of such nature as will inspire confidence in such capital to come to us."

I think in this they are perfectly justified, and point for such justification to the Government railroad. That the West was developed by private railroads does not alter the argument, for here again it was purely a question of natural conditions. The early promoters saw, not only a vast country of great possibilities agricultural as well as industrial, but they also saw a great outlet to the Western Continents, which promised large returns. In the East, it was different. The country was not promising for large agricultural possibilities; it was not promising for large mineral or industrial developments, and it did not show large immediate possibilities as a carrier route to foreign countries, being too near the routes long established, and provided with all facilities and advantages of a large population behind them, which lay to the south of these Eastern sections. The Government railroad, therefore, became necessary,—was undoubtedly a heavy tax on the Central and Western sections,—but was the life-giving principle to the Eastern ones, and now surely has paid back to these more populous sections all the expenditure in taxation they made for it.

The same principle now applies, in many cases, to Government aid in mining, and while it applies more generally to the Central and Western sections than did the Government railroad, yet it specifically applies, just as did the Government railroad, to the Eastern sections. It is my object in this paper to take up the discussion more from the Eastern standpoint, and apply to it especially the suggestions I desire to make, and further, to more specifically confine myself to the practical metals and minerals, rather than to the precious ones, leaving these latter to be championed by those who are better posted and more able to discuss their merits than I am.

To begin with, my idea of Government aid is practically on the same lines as the Geological Survey, which is carried through all districts alike, at exclusive Government cost, but to be devoted more to economic and commercial conditions than is the Geological Survey, which of its nature is more technical and scientific, and not of a specific material value to the individual, as a mining department would be.

The Geological Survey has already been of inestimable value, as a whole, and in many cases has done scientific service which has carried with it great commercial advantages; yet it does not cover the ground sufficiently, and a mining department, giving judicious and cautious aid, in showing the number, location and valuation of the minerals, is the supplement that seems to be required for this and many other less favored or more isolated localities.

The difficulty lies in adopting a method which cannot be subserved too greatly to individual benefit, so as not to swamp the Department with demands that would wreck any treasury, or could be made to further political aims. Especially in New Brunswick and Nova Scotia have we natural conditions that are difficult for an individual to take hold of in such a way as to give permanent and practical results. Our mineral resources have only been scratched on the surface. They are evidently, with few exceptions, not of a very large nature, and even those that were beginning to indicate more valuable properties have for many years lain idle or been looked upon with a large degree of uncertainty. Nature has not been particularly kind in exposing her secrets underground, excepting, perhaps, in coal, and yet already, in several cases of local government aid, valuable results have been obtained, where private capital had not felt sufficient courage, from the indications, to do that exploring necessary to show what really was available. The population, also, is thin. There are few large centres, and there has been little opportunity for knowledge as to how to proceed when a mineral has been discovered. The result is, that already a vast amount of private capital has been misspent, and properties abandoned at the very beginning, owing to this lack of knowledge on the part of the early prospectors. Then again, money has been put into many properties that were worthless, and would have been determined worthless by men having knowledge of mineral formations. Unscrupulous prospectors, I regret to say, "experts" have even taken advantage of this lack of knowledge to paint deposits in glowing colors, being themselves utterly indifferent as to ultimate results, after they had been enabled to spend a certain amount of time and to pocket their fees. Then, again, transportation facilities are poor, and frequently what would be deserving properties are not looked into further, because, unless they are of a large nature, it would be manifestly impracticable to give them the necessary transportation facilities.

To cover the ground for such work, I have the following suggestions to offer: The mining department having in charge this work should be divided into minor departments, covering various sections, all through

Canada, each of which requires a competent, honest, well informed man; fearless, and as free from political affiliations as possible; broad minded, and of good judgement and insight into human nature. From him would emanate the work to be done in his section, and he should exercise great care in the selection of men who would do the actual prospecting or development work of his particular section. It appears to me, that for New Brunswick, Nova Scotia and Cape Breton, one such man, or commissioner, as I will call him, should be sufficient; and he should have under him one mineralogist for New Brunswick, one for Nova Scotia and one for Cape Breton. These mineralogists should be like our geologists—cautious, conscientious, and with a full realization of the import of their work. Above all, they should not be given to jumping at conclusions. They should understand the formation of ores, of mineral deposits, and their relation to the geological formations. In the present day, when this branch of investigation is being so thoroughly gone into, and so much having been written about it by such men as Posepny, Emmons, Beck, Van Hise, Kemp, etc., and the whole formation of ore deposits is being more and more clearly understood from day to day, there should be no great difficulty in finding men capable of filling these positions. It would be merely a question whether the Government, in undertaking this work, would be willing to go into expenditure to get good men, especially at the beginning, who would then train up under them a corps of assistants, who could, in comparatively short time, be drawn upon to fill either additional positions, or vacancies which would be constantly occurring. These mineralogists should be definitely assigned to their sections, so that they would make it their special work to study the section, first geologically, and with what knowledge is now available, and then from the special mineral standpoint, when they would soon become thoroughly familiar with the work required. All such work needs going over and over the same ground again, each time with some new information, which brings out points and data overlooked, or unnoticed, or not quite understood on previous visits. It is only by careful co-ordination of all available data that accurate practical results are obtainable in mineralogical work. We have all had the experience of examining a location or deposit, and coming back to it again some time later, after having given it more thought, and having obtained all sorts of data, etc., to find that we looked at it in a very different way, and that many of the important factors appear to us, on the later examinations, very differently and more clearly than at first.

Fully as great care if not greater should be taken in the selection of these men as in the Geological Survey. The information here is concrete, and such that upon it large amounts of money may be represented. These men must be incorruptible, conservative, yet not too timid, nor too confident. As a rule, actual immediate results will come from their work. This will be tested and checked by experts from any part of the world, and in this respect it differs from the Geological Survey work, which deals by nature more with the large general questions of the whole formation, detailed as finely as practicable, but not subject to that quick, decisive test or accuracy of judgment or of work, and definiteness of results that will characterize the work of the Government mineralogist. I enlarge on this somewhat because, to me, the character of the man seems the gist and crucial point of the whole question.

These men could further be used for the inspection of mines already in existence, without at all interfering with the system of inspection of coal mines, which, being of a well established nature, should be kept separate, and continued as now with whatever modifications are necessary or desirable

The whole work would, of course, be under the direct control of the Mining Department, and this and the Geological Survey should work very closely together, and thus make the likelihood of success much greater.

Of course, we must look for occasional failure. There is no mineralogist who can look beneath the ground any deeper than any other man. He puts to use his knowledge and previous experience, but nature has a way of playing scurvy tricks, and she seems to be in a particularly tricky mood in these Eastern sections. The element of luck and good fortune rests, in a certain way, with all of us in our work, but this should be minimized by a well-planned, systematic course of work, and I only mention this because no man should be condemned too hastily, if he has been too cautious or too hopeful, as long as we see he has been conscientious in his work, and his reasonings have been logical.

Records, collections and general information all can be obtained from anywhere; yet the whole result hinges on the personality of the man. You can lay down no set rules. No definite lines of formation regulate them. They are only governed by general rules, and the specific formation is always the result of local conditions and disturbances, which are seldom alike in two places; hence the need of this extraordinary care in the selection of men, which, as a rule, we know Governments are not always inclined to exercise. Above all, there could be no greater misfortune than to endeavor to make this a political opportunity. This is, therefore, the most serious consideration that the Government has to keep in view in making its decision on this subject. It may probably be considered well to go slow, starting with certain sections, and let the work grow as the heads become familiar with the requirements, and as the results begin to show, and warrant further increase of force or work.

The matter of next greatest importance is the one of keeping proper records. There should be in the office of the commissioner a careful and complete record kept of every report made, giving in short detail the gist of the information, starting with the date of report, the name of mineral location, analysis, the owner the informant or examiner, the date of examination, estimate of quantity, and decision of examiner, with comments thereon; also a number corresponding to that of the report, for readily finding the latter in the files. The books should be sub-divided under the various mineralogical headings, thus: Coal, Iron Ore, Manganese, Limestone, Gold, Silver, etc., etc., Minor Metals, as well as such material of practical use as Sand, Building Stone, Clays, etc., etc.; so as to make it possible at any time to refer quickly to any subject, and get a general insight as to what it represents, and then be able, if desired, to immediately get the full report. Reports should be printed at not too infrequent intervals, and not too long a period after they have been made out. How much of the mineralogist's report should go into print is a question for the Commisioner to decide. Reports of importance should be printed in full. Reports of failure to find available mineral, or of minor importance, should be printed in extracts, giving a general outline. Anyone desiring further information could obtain this separately from the Commissioner's office. There can be no objection to this on any individual score, as no one who does not desire the fullest publicity as to his property has a right to call upon the Government for aid in examination or report. Anyone desiring secrecy as to his property should be made to do the work at his own expense. I can see right here a very great advantage to the general public, as the habit is only too frequent of having properties examined time and time again that are utterly worthless, and which each time are represented as new discoveries, or even as having had previous favorable reports made on them. I know of cases where properties have been optioned several times, with cash payments for option, by such misrepresentation. A quick examination of the Government records would immediately develop such representation, and prevent the further investigation of many worthless properties, which frequently are likely to lead to the subsequent condemnation of the whole section, or even of its people.

Particular care should be exercised in keeping the record of the drill holes. This is a matter in which we frequently come across cases of gross neglect, either purposely or unwittingly. I know of cases where drill work in very valuable measures was made absolutely worthless by the slovenly and incorrect manner of keeping the records. There should be specially printed and ruled sheets available at each drill, for the marking of every change in the core from beginning to end. Such sections should be blue-printed, and the blue-prints filed with the records. The compilations of such sections, when not too far from each other, are frequently of inestimable value in determining the strata and the thickness or continuity of ore bodies.

Another important feature is the proper keeping of collections, to which especial attention should be devoted. Accompanying the ores should, if possible, be samples of the foot and hanging walls. Specimens should be kept and carefully labelled from all properties examined, and also samples sent in should, in a separate place, be boxed and labelled, first, under locality, and second, under various mineralogical headings.

In the record book should also be kept a short outline of all information sent in to the Government, under the various mineralogical headings. This would include inquiries and statements of any nature, which may sooner or later become valuable to refer to.

The Commissioner's office should, in my opinion, be centrally located, so as to be as accessible as possible.

As to how far the Government should go in its expenditures on any one property, and what sort of compensation it should expect for its work, this is naturally largely dependent on circumstances. The rule adopted in many cases at present, I believe, is that the Government pays 45 per cent. of the expense, while the owners pay the balance. I am not quite familiar with what steps the Government takes at present to reimburse itself in full, in

case of valuable discoveries. As a rule the actual expenditure is not very great, and it would appear to me that the Government's expenditure, whatever it may be, should be practically a charge upon the property, to be paid for by this property, either in total, or on a species of royalty basis. In cases where the owners are manifestly unable to pay even 55 per cent. of the investigations, and yet the preliminary visit of the mineralogist indicates prospects that are worth while further investigation, then it would seem to me that the Commissioner, after referring the matter to the Head Department, should be permitted to make the Government investigation without calling upon the owner to participate in the expense, but in such cases, again, the whole expenditure should be a charge against the property, to be repaid to the Government out of any actual commercial results that arise therefrom, and an agreement with each owner to this effect should be entered into.

In such case, the Government assumes the full liability for only such investigations that prove valueless, and in thus wise directly carries out the whole essence of this proposition; namely, to develop what is good and what is worthless. It will also be a strong incentive to each section to be as cautious as possible in its expenditures and examinations, so as to have charged up to it at the end of the year the least possible amount of Government liability for which there can be no return expected.

An assay office or laboratory should be in connection with the work. Whether each section or Commissioner should have one under his control, or whether there should be one central Government laboratory, is a question for discussion. The central laboratory would be more economical.

The charges for Government samples would, of course, be included in the general charges against the property. For individnal inquiries a fixed schedule of charges should be had, in order to prevent the swamping of this department with non-paying work. I have little to say about this subject, because all general rules governing laboratories and chemists cover it.

The great value of keeping careful records, for future reference, even of ores that appear too lean to be worked at present, is evidenced by the fact that Scotland smelted last year some 880,000 tons of ore containing only 30 per cent. in iron, while England smelted some 10,000 000 tons of ore running from 30 to 33 per cent.; these being mixed with richer ores, domestic or foreign, and in some cases smelted alone. Hence, low-grade ores in this country may in time become of value.

As to the equipment required for the exploration, the first is the ordinary list of tools for putting down trenches, pits, etc. Then, when the property has been superficially examined, and some definite idea obtained as to the course of the formation and the probable extent and direction of the deposit, it is for the mineralogist to determine whether he will put down a short shaft or drive a tunnel in-a-ways, or whether he will use the drill direct. The two classes of drill, diamond and calyx, are the most desirable to use. The diamond drill is expensive, on account of the high price of the carbons, the difficulty of obtaining good ones, and the much greater care and experience required to successfully run it without too great a loss of carbons. The core also is small and not so representative. It is more likely to break up and crumble, and more difficult to measure the angles of formation through which it passes. Its main advantage lies in the fact that it will permit drilling at almost any angle. The calyx drill gives a larger core--from 2½ to 5 inches--admits of the use of either the steel cutters or the sheet barrel, according as the rock is soft or hard, and requires much less experienced or skilled men to run it, and would appear to me to be the more available under the special conditions which would govern this work. As to the comparative cost, I have seen such low cost on both the diamond and the calyx drill that I draw no comparison between them.

The report of the mineralogist should contain a surface description of the locality, its distances from various shipping or consuming points, the geological formation; then deal in detail with the character and formation of the ore; should describe its availability for mining purposes, the most economic methods, and any data pertaining to the economical mining; it should, further, give the transportation facilities, if any, or what transportation facilities would be required; refer to the available timber, the available population for mining purposes, and be as general in its details as practicable.

In this paper, I have purposely not discussed the questions of Government bounty on ores mined, the reduction or entire cancellation of Government royalties, under certain conditions, or of Government encouragement to larger and better school facilities for technical education. Each of these are subjects to be taken up separately, while I have confined myself to practically but one phase of the problem. That my suggestions may meet with opposition in some quarters, I have no doubt. Practising mineralogists and mining engineers may feel that it will interfere with their own work; yet why should it, any more than the work done by the Geological Survey interferes with practical geologists? On the contrary, I think it may stimulate private investigation on all properties that have shown favorable results, just as the work of the Geological Survey constantly leads to study and examination by others of such sections as indicate favorable conditions.

Of course, all of this is mere outline, subject to modification in many particulars, but it may act as a basis of discussion, and as such I submit it to the Institute, regretting extremely that I cannot be personally present to attend what I know will be a very careful and thorough elaboration of all matter bearing on this subject.

MR. R. C. CAMPBELL-JOHNSTON, M.E., Nelson, B.C.

The premises are granted, namely that Canada is more than favoured by Nature in minerals, these minerals to be regarded as raw material.

To promote the development of this raw material, the material must be wrought and manufactured as cheap or cheaper than in other lands, in order to share in the world's market. For cheap working the most skilled miners, workers and officials must be attracted to the country to secure the greatest output per man at least expense. To produce skilled workers technical education in the different branches of their labour is of paramount importance. To make life attractive to them, the conditions of working, sleeping and leisure hours must be made healthy, and the amonnt of wages saved above living expenses must be a considerable item. Therefore cheap living of good quality is essential, and inspection by Government of working and living places to ensure safety and health must be undertaken.

The law of universal habit to buy in the cheapest market and to sell in the dearest demands free trade in the supplies used to produce the raw material at the lowest cost. To encourage the manufacture *in situ* of the material, only when free trade exists to cheapen production, an export duty on raw material is a logical sequence, so that outsiders using our raw material are handicapped and pay a tax to ease our own. These factors, free trade und export duty, are indirect bounties of use when the raw material is in abundance; when the raw material is absent or scarce with the fuel to manufacture it, then no bounty can build up an industry.

The sturdy independence of Britons, who have made our Empire throughout the universe, must be continually encouraged, and not enervated by grandmotherly government, but by allowing private enterprise to work out trade problems untrammelled by interfering laws.

The living pictures of this are before our eyes, comparing Germany with her bounty-fed industries and Great Britain with her free trade (the greatest good to the greatest number). Who in troublous times weathers the storm most successfully?

Should a Government encourage cheap transport by controlling freight rates? Certainly, and even more so when the nation does not own its own transport facilities, since transport is one of the means of cheap production and manufacture.

A Government should insist on the employers furnishing statistics. It should then collect, tabulate, and widely publish the general results as an incentive both to fresh capital to invest here, and new buyers to do business here. Monographs, maps, and bulletins to advertise and facilitate the present and fresh production of mineral in a country can only be worked out by a Government.

Should a Government institute assay offices? By doing so it works a gross injustice to private interprise. The profession of assayers and metallurgists protect themselves by forming associations and by getting private acts passed to weed out frauds and unskilled men. Let them be treated like other professions as doctors and lawyers, and let them work out their own salvation, and uphold their *esprit de corps*. Skilled metallurgists are scarce enough already, without a Government by competition discouraging new recruits.

A Government's duty towards mining is to allow it to be self-supporting, to enable it to produce cheaply at home by enacting light taxes, to collect and publish any data to push a market.

It should remember that the world is their market, and not only its own country. The working classes of the United States pay dearly among themselves, that their surplus products may compete in the world's market. This is a quixotic and shortsighted policy on their part to enrich their employers, and is not the greatest good to the greatest number.

MR. W. A. HUNGERFORD, Deloro, Ont.

I do not propose to go into all the many important questions, such as the laws, inspection, statistics, etc., but will confine my remarks to what I consider would be the practical result of a strong liberal mining policy. At a meeting held in Madoc on the 15th October of the representative mining men of this section, to consider the question of a bonus on arsenic, I stated what I considered the wisest and best policy our Government could adopt in order to open up and develop the mineral industries of Ontario, which, of course, would apply to the Dominion as well. My letters also appeared in the Belleville *Intelligencer*, Marmora *Herald* and the North Hastings *Review*, which have been commented on by many of the leading papers of the county. Having, therefore, already expressed my opinions on this subject, I must of necessity refer to some of my former remarks.

I have already advocated that the Government should assist mining along the lines that the Government of Australia assists that industry. And if you will consider this policy you will see how thoroughly in earnest they are, and how practically every detail in the interest of mining is assisted. Their policy has been successful, and it is safe to say Australia would not stand as high today as any of the great mining countries of the world, had it not been for the policy of their Government. The fact that the Government had faith in their mineral deposits and encouraged the mining industry in every legitimate way, gave capitalists confidence and the result has been success.

The mining policy of Victoria, New South Wales and West Australia are about the same.

New South Wales maintains public metallurgical works for treating all kinds of ore free of charge. They also maintain public assay offices, free assays to *bona fide* prospectus, charges to others.

An appropriation of $125,000 yearly is made by the Government Prospecting Board to be spent in assisting *bona fide* attempts to sink shafts, and part of the money goes to keeping up at least 13 diamond and other drills which are used in locating and exploring the size of deposits, part is spent in assisting private miners to sink shafts, who for lack of means could not carry on the work. In case either attempts prove satisfactory and a mine is the result, a refund is demanded by the Government as soon as the industry is paying dividends.

4. A school of mines is kept up to train men in mining.
5. A full staff of geologists is kept up at the Government's expense.

West Australia besides maintaining assay offices and assisting in development work, maintains public stamp mills for treating ores in different parts of the country for the use of prospectors to test ores, and also for custom mills at no charge to prospectors. They also maintain a full staff of experts to do Government work.

It is difficult to imagine what better policy could be pursued to open up and develop their country than this. Apply such a policy to Canada, and I am not stating impossibilities when I say that there is no reason why we should not be one of the largest gold producing countries in the world. When you consider our mineral belts, reaching from Cape Breton to the Yukon, I doubt if there is any country that would compare with us.

Knowing how satisfactory the results have been in Australia, it is hard to understand if our Government had faith in the mineral resources of this country, why they have not had some such policy as this before now. It has not been for the want of information regarding our mineral deposits, nor is it from the want of satisfactory reports from the best experts in the Dominion. But from the fact that our representatives have not brought this question before the Government as they should have done.

What we want is practical assistance, on the lines mentioned :—

1. A Dominion Department of Mines.
2. Free assay offices for prospectors.
3. Government assistance in developing properties.
4. Government stamp mills in certain sections to test ores for prospectors free of charge.
5. A full staff of geologists kept up.
6. A staff of experts to do Government work.
7. A school of mines to train men in mining.
8. Government metallurgical work (as in New South Wales) for treating all kinds of ores free of charge and determining the process to treat the same.

If a policy like this were adopted and assistance given to those who from want of experience or want of capital could not develop their properties, I venture to say that in five years, mining would be established on a permanent and successful basis. The fact of the Government having confidence to expend money in developing a property, would be one of the strongest recommendations for capitalists to invest in that property. The fact that the property had been examined and reported on by the Government expert and the work done by practical men, under the supervision of a Government mining engineer, with favorable reports would place the owner of the property in a position to sell at a figure that he could not otherwise expect to do.

If assistance of this sort were given to this district where we have large deposits of free milling as well as refractory ores carrying enough mispickel to supply the world's demand for arsenic. How long would it take to see a dozen mills in operation in North Hastings alone? All we want is developed properties in order to get capital to work them. Let the Government assist us in doing so and I have no doubt but that the experiment would be a success.

MR. JOHN McAREE, Rat Portage.

Inspection.—In addition to thorough inspection of the mine, mill and other works in order to secure the greatest protection against accidents, the sanita y condition of the camp should come under investigation to see that the sleeping and dining apartments are cleanly, and adequately ventilated. The system of water supply for the boarding camp should be carefully examined, especially as to the source of supply.

Statistics.—In addition to the usual information regarding the output of the mine, number of men employed, &c., an attempt should be made to collect statistics as to the cost of mining, sinking, drifting, explosives, duty of stamps, &c.

Monographs, Maps and Bulletins.—Monographs on various subjects connected with mining might be advantageously published by the Government. The little Manual on Explosives, by the Ontario Bureau of Mines, is a good example. A good manual on absolute mining is needed; also a manual for mining investors, giving such general information on the subject as will enable those intending to put money into mining ventures to secure an investment instead of a speculation. An intelligent mining investing constituency is one of the needs of the Canadian mining industry to-day. It is growing, of course, but it will pay to foster it.

The most complete maps obtainable should be accessible to all mining men, and to any who may become investors. In new districts, meridian and base lines, to serve as tie lines, should be run.

Bulletins should be issued monthly, and should appear in newspapers as well as in technical journals; this kind of news would be sought after and would cost the Government nothing for publishing. They should give information of working mines, new discoveries, laboratory work, etc. Those issued from the Government assay office at Belleville have been quite interesting.

Government Assay Offices—Are a good institution. The one at Belleville is a good example: there should be one at Rat Portage.

Duties—Should be removed from all technical literature, mining or otherwise. chemical and philosophical instruments and apparatus, engineers and surveyo s' instruments, assaying apparatus and supplies, and be light on all kinds of mining machinery. An export duty may be advisable in certain cases.

Technical Education—Is, of course, very important; must be obtained at the mining school. Each school should have a professor of mining engineering—a practical man who has had experience in mining—not a mere chemist or geologist. There should be adequate laboratory room for assaying and analysis, and a large collection of minerals and rocks illustrative of mining geology.

The mining inspector should be a practical man and a mining engineer of experience, and a sort of consulting engineer for his district. Such an officer would be invaluable in a new region, such as Western Ontario, *e.g.*, in giving hints on mining generally, in laying out work, etc. If mining in the district of Rainy River had been conducted under such an inspector from the beginning many thousands of dollars would have been saved, and the mining interests would have been in a much more advanced state than they are. There are agricultural colleges, experimental farms, travelling dairies. farm instructors for the Indians, and why not also mining instructors? The Indians know about as much about farming as the average Canadian in Western Ontario does about scientific mining. The latest phase in educational methods is to send the teacher to the pupil—witness our summer mining school. The knowledge acquired in this way is that which experience has shown to be actually needed, and the circumstances under which it is acquired are such as to ensure its being mastered and firmly retained.

MR. J. C. GWILLIM, B.Sc., M.E., Nelson, B.C.

Monographs, Maps and Bulletins.—During the past few years there has been a great advance in the mineral industry in Canada, and with it an increase in publications concerning this industry. The Geological Survey Department has to some extent supplied special information concerning our mineral resources, in connection with the general working out of the geology and natural resources of the country. This work has given us maps of a very large part of the Dominion, and very useful they have been towards the opening up of new districts.

In the West there have been special and early reports and maps of Rossland and of the Yukon by Mr. McConnell, and others on the Yellowhead Pass and Crow's Nest coal fields by Mr. McEvoy.

These have been of great and timely use. It is necessary, however, to also let the people know where and how such information can be obtained.

Individual enterprise, and the various organizations interested in development, publish more or less inaccurate maps and accounts of new districts some time before these districts receive official attention. This material is well advertised and extensively used. It is perhaps impossible to get reliable information at the time of the first rush of prospectors into a new district, but its economic resources can be looked into at an early date and receive attention from some authoritative source.

It is not enough to get an accurate and full report upon a district several years after the examination is made, and as long after a pressing need for the economic portion of this report was felt. Such work has a scientific merit and is necessary, but its economical usefulness has lost much by its late appearance. It seems advisable to have the earliest possible maps and bulletins of the mineral resources, in a separate form.

In the publications of the Geological Survey Department and the various Provincial Mining Bureaus we can get, on application, a great amount of information, courteously given, or at a nominal price. Ransacking this mass of information the mining public can get much that it wants, but the phases of mining are many, and while these reports are good for the time of examination, they fall short in describing mining development after a time. The geology and resources other than mining, once worked out in detail after several years' study of the districts, may be given in a standing report, good for all time.

Many of the mines and mining districts of the United States have received special examination from specialists in mining geology. Their work has done much to enlighten us concerning the economic and scientific aspects of mineral deposits. Evidence of the usefulness and demand for early bulletins upon mining operations may be seen in the publication of Mr. Carlyle's Bulletins of Trail Creek and Slocan, in 1896. Messrs. Schrader and Brooks, of the U.S. Geological Survey, published an account of the Nome gold fields before the second season opened in that district. This was very useful to the few who read it.

At present there is some demand for information concerning the Horse-fly River district of British Columbia, but there is very little of a reliable character to be obtained.

Canada in the East has some mineral resources which are both valuable and uncommon, such as the asbestos, nickel, mica and corundum. Coal and iron in both east and west are very important. The gold, silver, copper and lead of British Columbia and the Yukon is a great mineral asset.

A better knowledge of these mineral resources is needed. Information contained in statistics, maps and bulletins, prepared from reliable sources and *widely distributed* will do much to relieve the mining industry of the gambling element.

The Provincial Mining Departments do very well in collecting statistics and accounts of the year's progress in the several Provinces, but they lack unity, and depend largely upon correspondents and inspectors. Office work takes up much of the time of those who are qualified to make field examinations. There is no central office from which the latest information concerning mineral developments throughout the Dominion can be obtained. When it does exist it should be well advertised.

MR E. A. SJOSTEDT, Sault Ste. Marie.

In expressing my opinion in reply to this wide and important question I will avail myself of treating the subject in the order and from the different standpoints suggested by our Secretary, merely limiting the same to the more specific question, How the Dominion and Provincial Governments may promote the interests of mining and the development of the Canadian mineral resources—by the judicious framing and liberal interpretation of their mining laws, by the intelligent inspection and safeguarding of the mining operations, by the systematic use of mining and mineral statistics, by the issuing of monographs, maps and bulletins, by maintaining an efficient assay office, and a high standard of their technical schools, by a careful and just but always most liberal consideration of the demands—in the way of light royalties and duties, and sufficiently high bounties and protection—of every individual or corporation with a *bona fide* proposition to establish a new industry or the opening up of a new mining district.

Laws.—Owing to the diversified character of the mineral resources of Canada only a very general Dominion law would apply and be effective only in the unorganized portions of the older provinces and in those provinces which are not as yet vested with full legislative powers. The mining interests of this country would, therefore, be best promoted by laws framed by each province to meet the local requirements, and by legislatures fully conversant with those conditions. Such laws should aim to simplify the formalities by which a secure title to a mining property may be obtained, avoiding as much as possible the triune control of the lots, resulting from the sale of the timber to one person, the agricultural right to another, and the mining right to a third party.

Inspection.—The inspection of mines should be under provincial control, and the regulations for the guidance of same should be prepared by a special board appointed by the Premier of the Province, composed of the Director of the Bureau of Mines, one resident mining engineer and one resident mines' operator, of such wide range of experience as to make them familiar with the different kinds of mining as well as with every detail of the same. The Director of the Province should be a mining engineer of high repute, by preference a graduate from a Canadian Mining School, or else from an American or European College of high standing; he should also have been actively engaged, and have held responpositions as mines manager. Among his duties would be to make annual visits to each and every active mine, assist in advice wherever requested, and in general take an interest in the development of the same. Subject to the approval of the Premier, there should be appointed by the Director a sufficient number of district inspectors whose duty it should be to make frequent visits (not less than four a year) to each mine, besides keeping the director posted on any new mineral discovery made in his district, stating character and importance of the same. The district inspectors should be practical miners of wide experience and with sufficient education to know the more general minerals and rocks, and to enable them to report intelligently the conditions of the mines and the compiling of statistics (in regard to number of men employed, their different nationalities, quantities and qualities of material raised, number and cause of accidents occurring, etc.) They should also be residents of the district to which assigned. All orders or instructions to the mines owners as regards the safety and precautions to be observed at the mine should come direct from the Director, but the district inspector should be vested with full power for inspecting mines under his jurisdiction at any and all times, and the mines owners requested by law to give the inspector (after his credentials having duly been presented to the manager in charge) a courteous reception and ample opportunity for carrying out his duties, including the obtaining of maps and data for statistics desired.

Maps, Monographs and Bulletins.—All efforts should be made on the part of the Government to secure and make public the geological conditions at each mine as developed, and through the Geological Department and the Provincial Mines Office aid in the work in making such maps and plans as would be best calculated for the intelligent prosecution and the further development of the mineral leads discovered. A great assistance in this respect would be a more detailed work by the Geological Department which possibly could be accomplished by offers from mining corporations to bear a portion of the expense so far as their individual holdings may be affected.

The issuing of monographs and bulletins on any subject of interest to the mining fraternity and their *early publication* and *free distribution* to every mines owner and professional mining engineer in the Dominion would be a great boon, and an advantage which would greatly assist in promoting the development of the mining industry. Mines owners should be compelled to make proper surveys and accurate maps in connection with the progress of the mine work and to furnish copies of such maps to the Director whenever so requested; and copies of these maps, as well as reports about any mine or mining prospect recorded in the Director's office should, for a small consideration, be provided to persons making such requisitions and having consent thereto of the mines owner.

Government Assay Office.—A Dominion Government Assay Office, well equipped and in charge of a competent staff is an essential auxiliary to the Geological Survey; but for the accommodation and advantage of the prospector and mines owner in determining the value of any mineral find, a Provincial Assay Office in charge of the Director is necessary, and the same should be maintained at such a point of efficiency as to secure quick returns from samples submitted. Such replies should aim more at giving practical information than abstract results, however, and should be free of cost; but more specific information, entailing minute investigation and accurate quantitative analysis should be given only at the discretion of the Director, he being guided in such matters by the general importance and interest of the subject matter to the mining industry generally.

Royalties, Duties and Bounties.—The question of royalties, duties and bounties is one of political economy principally. To promote the interest of the mining industry the royalties should be made light and be assessed per ton saleable product recovered from the properties operated under lease from the Government; and on a patented property a tax proportionate to that of other taxable estates would seem proper. Duties on all mining and smelting machinery, as well as on apparatus for the manufacture of coke, charcoal and peat, should be of the lowest; and in cases where the machinery and apparatus required are not made in Canada but as a specialty at the factory of a foreign country from which they are ordered and imported, the same should be admitted free of duty. Bounties should be given to mine owners in the way of Government assistance in construction of good roads and their maintenance or any other transportation facilities, at the recommendation of the Director. Such assistance would not only help in the development of the mines, but also in opening up the country for settlers and thus be a lasting incentive to other new industries.

Technical Education.—It is hard to over-estimate the benefit to the mining industry generally, and the metallurgical industry particularly, that will result from the paternal care and liberal expenditure of money by the Government for the technical education of a sufficient number of mining and metallurgical engineers. As a rule the man who has acquired his knowledge of mines and minerals by years of practical experience only has at the same time fallen into grooves and ruts which seriously handicap him in his efforts to obtain successful results; and the guidance by a broader and more enlightened brain is becoming more and more essential in these days of competition and close margins. Whatever the Government can do, therefore, to raise the plane of intelligence of the men engaged in mining and allied industries would doubtless tend to promote the development of its mineral resources. The strength and prosperity of a country rests to a very large extent on its mineral wealth and the degree of development of its mineral resources, and to attain this in the highest degree the whole educational system should be on the highest plane, to reach which the liberal support of the Government and individual endowments to high institutions of learning as well as to the great common school system would be a necessity.

Technical schools and universities of the Dominion should be sufficiently equipped and endowed to provide the best course in mining, engineering, metallurgy and chemical and electrical engineering, and the endowments of the chairs should be large enough to attract men who already hold lucrative positions as captains of industrial enterprises. The establishment of closer relations between the university and the mine and factory namely is of the greatest importance. The fact that instructions were to be given by professors who themselves have participated in active operations instead of by book worms possessing no knowledge of the practical side of the subject would be an incentive to a class of young men eager to lay hold on the world of industrial activity, which in itself would be a great stride forward in an educational system of this kind. The courses referred to should be of a practical as well as a theoretical character, so as to not only equip the student with a broad, firm, scientific knowledge as a basis for further work, but also afford him the time and opportunity necessary for a certain amount of practical experience which will give him some kind of "working idea" of his profession. For instance, a chemist on graduation should not only have a theoretical knowledge of his subject, but he should be required to understand the reactions involved in the assays and analyses of the various types of ores and technical products He should also have such a drill in these manipulations that he will know the various "short cuts" and "quick methods" which are required in the technical laboratory of today. Unless a graduate has had some such drill it takes nearly as long to "break him in" in a technical laboratory as it does an uneducated boy.

The summer vacations during the college years in question should be devoted not only to visiting mines, furnaces and mills for a stipulated number of weeks, but in performing actual work and detailed duties in connection with certain specified operations in mining, smelting, converting and refining—this to be necessary part of the course, just as is the practice in some of the European countries where the standard of technical education is the highest, and where the advantages of this practice have been fully demonstrated bp the high degree of perfection reached in the industries mentioned.

DR. W. L. GOODWIN, Kingston.

In reply to your request for my views upon the ways in which a government may promote technical education, I wish in the first place to point out that the word *technical* is used in two senses,—(1) As covering manual training and what may be described as trade schools, and (2) as referring to higher education in applied science Governments have duties in both these directions; and both Provincial and Dominion Governments have so far been active in the discharge of these duties, as witness the agricultural college and schools, the experimental farms, the dairy schools, the travelling dairies, and the Ontario grants to schools of practical science, and to secondary schools (to aid them to establish technical courses). But if Canada is to keep pace with the rest of the industrial world, much more must be done by Governments to forward not only technical education in both senses, but also scientific education in the broadest sense of that term. For *applied* science implies *pure* science; and the nation which relies on others to carry on scientific discovery, and thus borrows its science for application, is in a position which is neither advantageous nor self-respecting. Through lack of scientific schools and colleges and of the scientific spirit among her manufacturers, Great Britain has lost industry after industry which rightly belonged to her. She is now in the humiliating position of supplying the greater part of the raw material (anthracene) to Germany for the manufacture of olizarine, a manufacture worth $20,000,000 a year; and her dyers import the manufactured article. She is in the same position now with regard to the manufacture of indigo, which has heretofore been a distinctly British industry with a turn-over of more than $15,000,000 a year. But the German dye manufacturers have spent $5,000,000 and twenty years of research in finding a manufacturing method for converting napthalene (largely from British coal tar) into indigo; and they have succeeded. The statistics of trade show that the German synthetic indigo is rapidly taking the place of the product of the plantations of India. Already one-fourth of the world's supply is synthetic indigo. These are two instances of the way in which those British industries have suffered which depend more particularly upon scientific research for their advance. At least a generation has been lost,—three decades of apathy; but at last an earnest effort is being made to retrieve the position; and three great forces have been brought to bear: (1) Imperial legislation and grants of money, (2) municipal aid, and (3) private munificence. In all these respects we in Canada have made a beginning, but *only* a beginning, and I shall confine my letter now to a short discussion of the directions in which the Dominion Government might reach out to aid technical (or preferably, *scientific*) education. It is quite plain that the resources of the provincial treasuries are very limited, and that the provinces unaided will not be able ty keep pace with the needs of education in applied science. While education is set down in the British North America Act as in the jurisdiction of the Provincial Governments, there is nothing in that Act to prevent the Dominion Government from giving aid to education. Indeed it has already adopted the principle in establishing the Royal Military College (which has turned out more engineers than soldiers), the marine biological station, the experimental farms (stations for scientific research in agriculture), and the other means for disseminating a scientific knowledge of agriculture and forestry. But it should now turn its attention to manufactures and to metallurgy and mining, and formulate a comprehensive policy of aid to scientific education, and particularly to those parts of it which have more direct connection with industries. It is always good policy to strengthen the forces already working. The Geological and Topographical Surveys are in reality institutions of scientific research. The same may be said of the corresponding parts of the Departments of Fisheries, Agriculture, and the proposed Department of Mines. Much can be done to strengthen these, by providing greater facilities for work, particularly for research, and by paying such salaries as will attract and keep men of the first rank. Following the example of the Imperial Government, the Dominion might well establish in existing scientific colleges regius professorships of subjects bearing upon industries of national importance. The founding, equipping and main-

tenance of research laboratories would be a paying investment of public money. Governments are wont to plead that in such matters they must not be in advance of public opinion. But there is public opinion *and* public opinion, and in this case the matured opinion not only of scientific men but of the leading manufacturers is in favor of a vigorous and expansive policy. The Canadian Manufacturers' Association has recently been instrumental in forming a Canadian branch of the Society of Chemical Industry, a British institution which has done much to awaken interest in scientific education in Great Britain. The Manufacturers' Association has also asked the leading Canadian Universities to make provision in their curricula for the special education of men for a business career. Manufacturers, mine owners, and others requiring men with technical skill and education are everywhere calling for applied science graduates to fill the most responsible positions. Here is the kind of public opinion which will justify action on the part of the Government.

Germany spends freely upon both universities and technical high schools. The latter should rather be called engineering colleges. They rank with the universities and grant degrees in engineering. The University of Berlin has an income of $715,000 a year, and the Government contributes 83 per cent. of this. Another at Bonn receives from the Government $250,000 a year; and similarly for other towns. The technical high school of Berlin receives $165,000 a year from the State, that in Hanover $75,000, and the Aachen school $80,000. In Great Britain the direct grants to universities and technical schools are still small, ranging from $10,000 to $12,000 a year for each of twelve university colleges receiving them. But large annual incomes available for technical education are now being derived from the operation of the Customs and Excise Act of 1890, by which a sum of about $3,750,000 was set aside for this purpose. There is also an annual grant of $750,000 divided among the four Scottish universities. In the United States scientific education is generously supported, not only by the State legislatures but by Congress. The Morrill Bill of 1862 provided funds for "colleges for agriculture and mechanic arts" by the sale of public lands. The amendment of 1890 provided for making good any deficiencies by direct payment from the United States Treasury. The Congress of 1900 passed a bill providing appropriations "to establish and maintain schools or departments of mines in connection with colleges and universities."

It may be urged that Canada is too young to begin this kind of work and that it should be left to gradual development by private enterprise and individual munificence. This is the policy which Great Britain has pursued up to the last few years, with the disastrous results already indicated. On the other hand Germany initiated her system of technical education more than one hundred years ago. At an even earlier date the University of Göttingen had a course in technical chemistry and technology, and Beckmann (1777) published the first text book on the subject. It dealt with weaving, dyeing, paper-making, brewing, starch, oil, tobacco, glass, sugar, gun-powder, &c. In 1796 this university (in a comparatively small town) had two professors of chemistry and one of technology. Before many years had passed, the other German universities had followed Göttingen in making provision for the technical side of science and in particular of chemistry; and in addition the technical high schools had been founded. Many of these have been in existence for more than half a century; and, in the words of a recent British consular report, "it has been found that the foundation laid during the scientific courses at the technical high schools formed the soundest basis for the practical experience to be gained during professional life." How these results are attained may be indicated by a glance at the staff of instructors as compared with the number of students in the chemical departments of some of the technical schools. The Berlin school has 44 instructors for 278 students; the Stuttgart school, 10 for 88, and the Carlsruhe, 15 for 139. Compare these figures with those for some of our universities. Toronto has 9 instructors for 594 students of chemistry; Queen's has 5 for 220; and McGill has 14 for 410. It appears, then, that we have very much to do and a long road to travel before we can take our place with the most enterprising manufacturing peoples.

But will it pay? In chemical manufactures alone Germany produces about $250,000,000 annually. If, as Beaconsfield held, "The chemical trade of a country is a barometer of its prosperity," Germany has become very prosperous. Her chemical trade grows. The present crisis is an incident merely and the chemical trade is the only one not seriously affected by it. The electro-chemical industries of the United States are now worth $100,000,000 a year. These are examples of industries which can be built up only upon a foundation of scientific education. The latter is a direction in which Canada is certain to make great advances, if her population receives a sufficiently thorough and widespread education. There is no other country with such a great amount of water-power available; and this will inevitably give us the advantage over those manufacturing peoples which depend on coal. The cheapest way of generating elecricity is by a favorably situated waterfall. Thus, given raw materials of the right sort, and Canada can compete successfully with the world in electro-chemical industries. But the application of electricity for such purposes is comparatively new, and advances must be made by devising new processes and new applications, such as, for example, the reduction and refining of metals which are now worked by other and more expensive means, and the decolorizing and purification of beet sugar. Each country has problems of its own to work out, differing according to the varying conditions; and no country can afford to depend upon help from without to solve its problems. England is now importing 90 per cent. of the dyes used in her dyeing industries, although the beginnings of the manufacture of artificial dyes were made in England, and it only required a widespread appreciation of the value of scientific education and research to have secured for her this immense industry. As it is, she exports the raw material and imports the manufactured articles. Germany solved the problem of finding uses for England's immense supply of coal tar, and Germany reaps the benefit.

A few examples of what might be done:—We have some of the largest and best deposits of pyrite to be found anywhere in the world. One of these is now being worked and the raw pyrite is shipped to the United States for the manufacture of sulphuric acid, &c. We import the acid for the manufacture of nitro-glycerine, &c. The pyrite is worth three or four dollars a ton. Each ton will make about 1½ tons of acid, worth $40.00. It would certainly be a great advantage to make our own acid and even to make it for export. If this were once begun it would be the basis for a dozen other chemical manufactures in which sulphuric and sulphurous acids are used. Another problem—one involving both mechanical and chemical engineering—is the utilization of our immense peat bogs. This problem is being worked at in Europe, particularly in Norway and Sweden, where peat is becoming constantly of more importance as a fuel. It is also looking up as raw material for the manufacture of paper. Experiments have been made by the Rathbun Co. in Deseronto to test its value in the charcoal retorts. But we are still far from a solution. Again, Canada is certain to become a great pulp manufacturing country. Immense quantities of sulphite waste will be produced. What is to be done with this waste? Although there has been much investigation, no process of utilization has yet been devised which gives complete satisfaction. For such investigations as have been indicated here, the highest scientific skill is required, and this must be combined with a knowledge of the economic conditions prevailing in Canada. All this implies that the work must be done mostly by Canadians, and that they must be educated in Canada. Our duty to ourselves seems plain. We must devote to scientific education a sufficient part of our revenue to provide the best scientific and technical schools and colleges for the youth of Canada. Such education is necessarily expensive; but the experience of those nations which have tried it prove that it is cheap at any price. The Canadian statesman who is far-seeing enough to inaugurate an adequate system of Dominion aid to scientific and technical education will win his place in the history of Canada.

MR. JAMES McEVOY, Fernie, B.C.

In considering this question, it will be admitted, in the first place, that such aid should not, except perhaps in the commencement of an entirely new enterprise, take the form of a spasmodic attempt to foster any particular industry. The plan of action should be broad enough to include all.

The great successes of to-day in mining are generally due to the proper application of knowledge gained in many previous attempts. Even the complete failures of the past often materially help to present success. They have been as danger signals on the road, and at least enable the new comer to avoid falling into the same errors of his predecessors.

So much being admitted, it will be seen how useful a careful monograph of some of our older mines would be. It should contain an honest criticism of their workings, wherein they failed, as well as where they were successful. The effect should be to stimulate the miner of to-day to better efforts in the right direction. It is certainly within the functions of a government to do this, in fact it has been done to some extent at least by the United States Geological Survey.

It is necessary, however, to do more than look backward if we are to



MR. R. D. FEATHERSTONEHAUGH, M.E.,
General Manager, Atlin Mining Company, Atlin, B.C.

accomplish much. The best methods of mining and treatment must be studied, and the knowledge made available to the operators, and then the necessary raw material to work upon must be found. By helping in the discovery of such suitable material a government can best promote the mining interests, and it seems to fall naturally to the lot of the Geological Survey Department to furnish the information required. There is no disputing the fact that this department has done, and is still doing, really good work, but the complaint is made that it is too hard to get at. Very often there is as much reason for the complaint as there is for admitting the fact. To illustrate the point, let us take for example the industry with which the writer is best acquainted, viz., coal mining in the west. Supposing some one wished to get a general knowledge of the coal deposits in that part of the Dominion, and consulted the Geological reports for that purpose. What information there is, has been published of course, but it is scattered in fragments through about twenty huge volumes, to the last fifteen of which there is not even a general index. Even a man who has spent years of his life in the department will find it difficult to discover any particular reference. Imagine then the predicament of an outsider.

Now, if the whole of this information were concentrated in a monograph or bulletin on the Western coals, and the bushels of chaff fanned away, it would be possible for anyone with ordinary intelligence quickly to see just how much was known about the subject. The work should be freely illustrated by diagrams and sections, and as much as possible placed before the public in a graphic form.

The same reasoning will apply with equal force to any other mining industry in the country.

Even if all this were done, however, it does not by any means meet all the requirements of the case, as it only makes available the information of the past. It is necessary to reach out after new discoveries. More particular attention might well be called to places where, owing to the geological conditions, further discoveries may be reasonably expected.

In order to have a reliable account of our mineral wealth, it is necessary to have more geological field work—good work, and more of it by experienced men. Then have it placed before the public in an available form.

It need not be inferred from the foregoing that purely scientific research should be abandoned or even neglected. Such work often leads to the most practical and important results. The theoretical and the practical should go hand in hand.

The separation of these into two departments, or separate branches of the one department, unless closely in touch with each other, would be a grave mistake, as in such a case neither branch would be likely to avail itself promptly of the information gained by the other. It would also mean a duplication of work, and the unnecessary and wasteful expense of duplicate laboratories and libraries.

Until there is some definite plan of action decided upon, and there is a reasonable hope that suitable men can be found to fill the different parts, it would be useless for a government to pass any largely increased vote of money. One thing at least is certain, something should be done. It is possible that by picking out the best points in the various opinions on the subject a decision may be arrived at, which, if carried out, would greatly benefit not only the mining industries, but the whole of our Dominion.

MR. J. T. DONALD, M.A., Montreal.

By these I understand offices where any individual can have samples of ores assayed free of charge or at a nominal cost, *i.e.*, in reality at the public expense. Although I am an assayer myself, I am in favor of equitably conducted Government Assay Offices. These if properly carried on should be a boon to prospectors and residents of regions where economic minerals are likely to be found and in no wise harmful to the private assayer. From the point of view of a private assayer, the only fair way in which to conduct a Government Assay Office is to man the same with a staff, the members of which receive a fixed and adequate salary and devote their whole time to the work. They should not enter into competition with private assayers in canvassing for the assay work that is required by those engaged in mining operations. A Government Assay Office will undoubtedly take away from the private assayer work that would naturally go to him, but in the end the private assayer will be more than compensated for such loss by the demand for assaying that will arise as a consequence of the work done by the Government office.

MR. J. WALTER WELLS, Belleville, Ont.

In my opinion the proper function of such offices or testing laboratories is that of acting as referee or umpire in cases of disputes between different assayers who may report differently on the same sample, and also in case of disputes as to grades or qualities of ore between shippers and the smelters. A large proportion of the work done by Government Provincial Assay Office here is umpire or checks on assays in case of parties buying properties, or ore, who may wish to check the reports of the owners of the property or ore. I would like to see more done along this line.

Coal and Iron Production in 1901.

The following returns have been received of output of Canadian collieries and blast furnaces for the year ended 31st ultimo. We hope to complete the list in our next issue :—

DOMINION COAL CO.

	1900.	1901.
Dominion No. 1	538,237	641,543
" " 2	610	23,635
" " 3	68,831	308,964
" " 4	25,428	8,341
Caledonia	511,874	640,688
Reserve	632,056	730,378
International	222,703	208 234
Total tons raised	1,999,737	2,561,783
Recapitulation		
Shipped	1,829,199	2,345,645
Land Sales	2,438	2,514
Collieries, Railways	81,075	123,022
Employees	24,258	27,732

DOMINION IRON & STEEL CO.

Iron Ore mined in Newfoundland	385,329
" from Spanish Ports	23,411
" " U. S. "	16,428
" " Cuban "	11,191
Pig Iron made	111,014
Coke made	192,873

ACADIA COAL COMPANY.

	1900.	1901.
Total Coal raised	286,045	270,253
" " sold	247,274	230,567
" Coke made	18,637	11,738
" " sold	18,624	11,736
Disposals		
To Nova Scotia	142,352	136,365
To P. E. Island	24,301	16,805
To Quebec	31,888	28,514
To Ontario	2,842	
New Brunswick	18,937	25,845
Colliery Employees	5,526	5,653
Engines and Coke Ovens	60,012	55,349
Total tons	285,858	268,531

INTERCOLONIAL COAL COMPANY.

Total output	204,402
" shipments	197,957
" Coke made	5,305½

Coal Disposals 1901.

Sold to	Round.	Slack.	Total.
Nova Scotia	62,171.11	13,778.04	75,949.15
New Brunswick	17,015.03	868.02	17,883.05
Prince Edward Is.	8,983.00	1,974.10	10,957.10
Quebec	50,807.03	14,075.01	64,882.04
St. Pierre	.....	.....	.....
Coke Ovens	.....	9,398.00	9,398.00
Colliery Employees	3,615.08	.....	3 615.08
Colliery Engines	4,049.15	11,221.03	15,270.18
Totals	146,642.00	51,315.00	197,957.00

CUMBERLAND RAILWAY & COAL COMPANY.

Coal Sales 1901.

	Round.	Run Mine.	Slack.	Even.
Nova Scotia	41,830¼	3,544½	14,457¾	47,452¼
N. Brunswick	124,110	16,061	15,857¼	18,237¼
Quebec	38,189¼	7,314¾	558	1,495½
United States	.....	526	.....	12 143
	204,129½	27,446¼	30,873	79,328=341,776¾

CANADA COALS & RAILWAY COMPANY.

Coal Disposals 1901.

New Brunswick	38,415
Nova Scotia	3,300
Quebec	14,643
Employees, etc	11,697
Total tons raised	68,055

ALBERTA RAILWAY AND COAL COMPANY.

	1900.	1901.
Output	181,801	217,034
Shipments		178,599
Labor employed on surface		62 persons.
" " underground		306 "

GOWRIE & BLOCKHOUSE COLLIERIES, LTD.

Output sales, 1901	20,700
Labor employed	170 persons.

INVERNESS-RICHMOND COLLIERIES & RAILWAY CO.

Output	13,500
Shipments	3,000
Labor employed	160 persons.

The work at this colliery has been mainly development and construction.

DESERONTO IRON COMPANY.

Canadian ore used	$98\frac{115}{2240}$
Foreign "	$17,602\frac{1405}{2240}$
Charcoal iron made	$9,975\frac{1134}{2240}$

CAPE BRETON COAL COMPANY.

	1900.	1901.
Quebec		1,546
Newfoundland	183	1,585
Nova Scotia	1,700	5,010
P. E. Island	5,767	1,519
New Brunswick	173	84
St. Pierre	327	.....
Labrador		350
Colliery consumption	2,250	1,640
" employees		1,020
Total	12,500	12,754

HAMILTON STEEL AND IRON COMPANY.

Canadian Ore used	50,093
Foreign "	56,849
Pig Iron made	67,512

LAKE SUPERIOR POWER COMPANY.

Iron Ore mined in 1901	261,203
" shipped "	230,941
" exported	161,384

CANADA IRON FURNACE COMPANY.

Midland Furnace.

Canadian ore used	53,964
Foreign "	9,725
Flux charged	18,520
Coke received	40,149
Pig Iron produced	33,648

Radnor Plant.

Ore mined	11,808
" purchased	1,500
Charcoal made	6,628
Charcoal Iron made	5,400
Ore charged	13,308
Fuel "	6,396
Flux "	1,737

NOVA SCOTIA STEEL AND COAL COMPANY.

Iron and Steel Output.

Nova Scotia ore used at Ferrona	18,619
Wabana hematite (Newfoundland)	32,801
Other foreign ore consumed (Cuba)	117
Limestone quarried	23,771
Coke made	23,540
Pig Iron made	26,793
Steel Ingots made	25,678

Coal Disposals.

Shipped	200,214
Intercolonial Railway use	2,888
Local sales	8,177
Workmen at colliery	5,214
Coal gifts to widows	229
Colliery consumption	16,157
Locomotives, shops, &c	1,108
Coke ovens and washer	2,622
On bank	575
Total coal raised	237,104

PEOPLE'S LIGHT AND HEAT COMPANY, HALIFAX.

Total coke made in 1901 from Nova Scotia coal.	8,480

H. W. MCNEILL COLLIERIES.

Coal raised from Anthracite Colliery	14,742
" " Canmore "	88,499

NEW VANCOUVER COAL MINING AND LAND COMPANY.

Total coal raised	593,608
" shipped	507,734

SYDNEY COAL COMPANY.

Total coal raised	8,949
" shipped by water	4,292
" land sales	2,549
" workmen	159
" engines	96

BRITISH COLUMBIA COLLERIES

Total output coal, 1,529,210 tons, of a value of $4,587,630.
Total coke made, 134.760 tons, of a value of $673,800.

LEGAL.

Interesting Case to Mine Owners—Adams v. Culligan—Howe v. Culligan—Judgment Given by Chief Justice Falconbridge at Toronto, January, 1902.

Adams and Howe were employed to do work in a mine in the Rainy River district. One night, when the engineer blew the whistle for the men to go to work, the bucket was hanging over the open shaft, having been left by the men when they came up at 6 o'clock. The men, believing that the engineer was at his post, and that the brakes and machinery were properly applied, stepped into the bucket—four men in all—and it commenced to move, and in a moment fell away and fell down the shaft. It was stopped by the engineer after it had descended about 90 feet, but the sudden drop no doubt threw three of the men out of the bucket, for they were found at the bottom of the shaft, one of them dead and the other two dying shortly afterwards.

The representatives of Adams & Howe, two of the men thus killed, brought actions for damages against the owners of the mine (alleging that their negligence was responsible for the accident, on the ground that the ladders and hoisting apparatus were in a defective condition at the time of the accident.

The evidence given at the trial proved that the brake, which was supposed to be strong enough to hold any weight that the hoist was capable of lifting, had, possibly by means of wear, become loose, so that when locked in place it was not sufficient to hold the bucket with the men in it. There was some additional means used for holding the bucket in place, namely, a friction clutch, which threw the machinery into gear. If both brake and friction clutch were applied they together would hold any weight. The engineer stated that the brake was properly locked, but he could not tell the position of the friction clutch. The cause of the accident no doubt was that the brake, while locked, was not sufficient to hold the bucket with the men in it, and that the friction clutch was not properly set, and therefore the bucket fell away when the men got in.

Those suing as representatives of the deceased men alleged (1) that the ladders provided for use by the men in going into the mine were in a defective condition, inasmuch as (*a*) they did not comply with the requirements of the Mines Act, and (*b*) that they were insufficient in number to enable the employees to enter the mine safely. (2.) That owing to the defective condition of the ladders they used the bucket to go down the shaft, and that the management authorized its use; that the bucket being a common ore bucket, was unsuitable for the purpose, and the mine owners were negligent in not providing a suitable means for the men getting to their work. (3.) That the hoisting apparatus was defective in that the brakes were not in proper working order, and had not been in proper working order for some time prior to the accident, to the knowledge of the mine owners or their foremen. The defendants denied negligence, and alleged:—(1.) That as the mine was in process of development, the ladders were as good as could reasonably be expected, and having regard to the mine that they were suitable for the purpose, and that there was no occasion for the men to use the bucket. (2.) That the men using the bucket did so at their own risk. (3.) That the men were guilty of contributory negligence in getting upon the bucket on the night of the accident without first ringing the bell so as to make sure the engineer was in his place.

The trial judge decided that the facts were as alleged by the representatives of the deceased men, and that the accident was caused by the defective machinery and plant of the mine, for the unsafe condition of which the owners were responsible. It was also held that the deceased had not been guilty of any contributory negligence. Judgment was therefore given against the owners of the mine, who were directed to pay certain sums as damages to the representatives of the deceased.

MONTREAL AND LONDON.

Report of the Committee of Enquiry.

The special committee appointed to enquire into the affairs of this company have reported :—

The causes which have produced the present depression by which the Company's shares have become practically unmarketable, may now be summarized as follows :—

1st. The failure, possibly under present conditions, the permanent failure of earning power, consequent upon the fact that as regards the mining operations of the Company, the ore and especially that recently treated, is both lower in assay value than was expected and is of such a character as that the gold cannot be extracted except at a loss by present methods, while the Company has neither the capital nor the credit necessary for the erection of a more suitable plant. As regards the trading operations of the Company, its financial condition would render impossible its business of buying and selling mines and mining stocks quite apart from the fact that no market now exists.

2. The losses upon capital account, arising from the great depreciation in market values, both of the Dufferin mine and of the mining stocks and locations belonging to the Company, and in a lesser degree to losses upon the equipment of the Dufferin mine which will require costly additions before it can be worked to full advantage.

3. The practically total loss of the Company's credit both with its bankers, the investing public, and its own shareholders, in consequence of which neither ordinary loans nor further capital, urgently needed, can be obtained. No industry in Canada has ever experienced such sudden inflation as that of the mining of gold and silver, and none has ever suffered such utter collapse. It is a regrettable fact that both these results may in the case of this Company be traced in a great degree to the extravagant estimates of profit, submitted by at least two of its mining engineers, made no doubt in absolute good faith, but made, nevertheless, with regard to possibilities and even to impossibities, rather than probabilities and consequently grossly inaccurate and greatly misleading. The losses which have been suffered by the shareholders of this Company are not to be measured by the losses of the Company itself, since in many cases the stock nearly valueless now has been purchased by its present holners, at a price twice, thrice, or even four times its par value.

As the shareholders are already aware, an option of issue, and a further option of purchase have been given upon the Dufferin mine. The period of the option having expired without any advice of its acceptance having been received from the holder, it now becomes necessary to provide for the payment of the outstanding liabilities of the Company, and, in case of its continuance, for the establishment of a cyanide plant which is regarded as absolutely essential to the possibility of the profitable working of the Dufferin mine.

Four courses of action have, so far, been suggested.

1st. To allow the Company to go into liquidation and its assets to be sold for the benefit of the creditors and preferred shareholders. There is reason to believe that in utter lack of confidence in the possibility of future profit, or in a petulent feeling of disappointment, many of the common stockholders will feel inclined to take this course, which can only result in total loss to them all.

2nd. To accept the suggestion of reorganization offered in the circular issued on the 27th November last. The objection to this plan is that a large number of the common stockholders will, for the reasons already stated, refuse to pay the proposed assessment, and will consequently forfeit their shares, losing the whole of their investment.

3rd. A suggestion offered to the committee by Mr. Copland, one of the directors, to the following effect :—

That the proposal of the directors in regard to new company be agreed to, with the proviso that any shareholder unwilling or unable to accept to the new stock on te ms proposed, will be allowed to retain his or her stock, and will be entitled to his or her share in any dividend declared after the stockholders who have put up money to place the Company in working order have received double the amount paid in. It is quite understood that these stockholders who have paid the call are not to be regarded as creditors.

4th. That the common stock of the Company remaining in the treasury, and amounting to 3,051,025 shares be issued at three cents per share to the stockholders, proportionately to their present holdings. It appears certain that if the shareholders generally decline to furnish further capital, the total loss of the common stock must speedily and inevitably follow. It is, however, the conviction both of the directors and of the members of your committee that the value of the assets is considerably above the total amount of the liabilities, and that by a wise expenditure of further capital the Company may yet in time be placed upon a dividend paying basis. The prospects of the Dufferin mine have been already stated, but it should not be forgotten that the Company has also other valuable assets. The shares which it holds in the Slocan Sovereign Mining Company would at once become of value if it were possible to resume the working of that company's mines, and the returns which have been laid before us support the conviction of the directors that with the lower charges for treatment which can now be obtained, these mines might be made immediately profitable if the necessary capital could be provided.

We beg to present for the information of the shareholders the accompanying summarized statement of the Profit and Loss Account from April, 1897, to October 31st, 1901.

Premium upon shares			$68,160 11
Profit on Slocan Sovereign property	$189,623 90		
Less not yet realized (see below)	89,452 98		
Amount realized in cash			100,170 92
Received for services of mining engineer			5,820 32
Total gross cash profits			$174,151 35
Less			
Expenses of flotation		$20,009 76	
Expenses of prospecting		2,404 77	
Legal expenses	$15,588 96		
Less transfer fees	845 19	14,743 77	
Total expenses		41,957 69	
Interest		14,852 43	
Losses on stock transactions	17,380 76		
Less profits	14,190 92		
		3,189 84	
Loss on Klondike expedition		31,601 82	
Working expenses Dufferin mine	77,452 07		
Less value of bullion extracted	54,121 85	23,330 22	
			114,932 00
Total net profit realized			$59,219 35
Add the following estimated but not realized :—			
On Slocan Sovereign Mining Co. shares		89,452 98	
On Bullion Mining Co. shares		25,000 00	
			114,452 98
Total profit realized and estimated			173,672 33
Represented by			
Dividends paid		117,767 89	
Balance at credit of Profit and Loss Account		25,904 44	
Contingent account		30,000 00	
			173,672 33

WAR EAGLE.

The following is excerpted from the Annual Report of the Directors submitted at a meeting of the shareholders on 25th instant :—

As explained in the last Annnal Report the pay ore of the main shoot changes to low-grade in the block between the 6th and 7th levels at a depth of about 800 feet. There was no evidence to indicate that this change was permanent, or anything but one of the usual low-grade stretches found in ore shoots, and every effort has been made to push exploration work at high pressure. A plan of deep and large scale development is being carried out, in the course of which the branching of the vein, together with complications caused by a system of heavy faults and dykes has greatly increased the delay and expense of exploring the veln.

The closure of the War Eagle mine by a general labor strike has restricted the mining of the past year to a period of about seven months. This further loss of time leaves us still short of decisive results from the great depth of vein made accessible by the rapid shaft sinking. The shaft, 1499 feet deep on December 31st, will reach the 11th level point at 1580 feet by the end of February, and sinking will then be suspended until decisive results are secured from the vein area then accessible.

The levels are as follows :—

6th	Level	754 feet in depth
7th	"	881 " "
8th	"	1057 " "
9th	"	1228 " "
10th	"	1378 " "
11th	"	1580 " "

The 7th level is sufficiently developed for the present, showing the ore to be low-grade.

The 8th level exploration is not yet completed. The vein exposed by it so far is low-grade or barren, but the work has not progressed far enough to be decisive, and there are still fair chances of finding pay.

The 9th level is well under way, but has not yet reached the positions where ore is expected.

The 10th and 11th levels have not yet been started.

Thus from the 7th to the 11th levels a new depth of 700 feet on the vein is now accessible, and its exploration by levels is fairly under way. What its contents may be as yet unknown and is a matter of luck. That its possibilities are great is evident from the fact that the main shoot down to the 6th level, a depth of 754 feet, has contained about 165,000 tons with a smelter's gross assay value of $3,100,000. From the nature of the ground it is impossible to see ahead or to make any prediction as to the chances of success or failure. That these chances justify the cost of exploring it to a decisive point is beyond question. Its contents, whatever they may be, will be reached as promptly and as cheaply as possible.

Ore shipments began January 3rd, 1901, continuing until the strike July 12th, and were restricted to a rate sufficient to meet current expenses; On resuming work in December the Canadian Smelting Works found that its sampling plant, which was being reconstructed, had been so delayed by the failure of manufacturers to deliver machinery that it would he necessary to postpone the receipt of ore for several months.

The ore shipments for the year amount to 19,864 tons, averaging $15.64 smelter's gross assay value. The average contents were 0.633 oz. gold, 1.08 oz. silver and 2.1 per cent. of copper.

The ore reserves now on hand in the mine are estimated at about 25,000 tons of about $14 smelter's gross assay value, (valuing copper at the prfce of 16.25 cents, which it has hitherto maintained).

The following is excerpted from the accounts for the year ended 31st December:

ASSETS.

Mines and Mineral Claims	$1,699,329 39
Cash on hand and in Bank	2,579 72
Stores on hand as per Inventory	18,122 44
Machinery, Buildings and Equipment	224,300 91
Furniture of Offices	1,882 04
Monita Gold Mining Co's Stock	89,589 94
Mugwump Gold Mining Co's Stock	28,275 68
Rossland Red Mountain Gold Mining Co's Stock	56,190 20
War Eagle Hotel Co's Stock	12,500 00
Accounts Receivable	25,734 14
Profit and Loss	242,730 54
	$2,401,235 00

LIABILITIES.

Capital Stock Paid Up	$1,750,000 00
Bank of Toronto, Rossland	256,171 07
George Gooderham	385,347 37
Accounts Payable	9,716 56
	$2,401,235 00

PROFIT AND LOSS ACCOUNT,

Dr.

To Balance brought forward		$197,514 93
" Cost of mining and developing WAR EAGLE MINE.	$143,051 56	
" Fixed and General Expenses while mine closed down	19,445 63	
" Rental paid Centre Star Co. for use of power plant for year	3,989 34	
" Loss of Value, defective Hoist and Compressor, replaced or reconstructed	26,424 64	
" Diamond Drill Prospecting	13,757 64	
" Interest and Exchange	16,786 95	
" Managing Director's Salary (2 years)	5,000 00	
" Toronto Office Expenses	1,166 43	
" Auditor's Fees	300 00	
" Travelling Expenses	200 00	
" Legal Expenses	176 91	
" Trail Smelter Examination Expense	1,335 40	
" Crown Point Expense	528 95	
" Richmond Group Expense	34 18	
" Sundry Expenses	875 16	
		233,072 79
		$430,587 72

Cr.

By Net Proceeds from Ore Sales	$191,579 88	
Less Provincial Ore Tax	3,840 95	
		$187,738 93
" Transfer Fees		118 25
" Balance		242,730 54
		$430,587 72

ANGLO-KLONDYKE.

The Directors' report and accounts submitted at the Annual Meeting on the 31st December state that the operations carried on between the 1st January and 30th September resulted in wiping off a loss of £7,000 brought forward from the previous year and a profit of £9,313, after writing off considerable sums for depreciation and for redemption of development. The total amount of gold recovered and other revenue during the past season was as follows:—

Fox Gulch Mines	$100,560 16
Goheen	51,502 53
Bonanza Lay's	12,956 71
J. F. Goheen—Lay	7,803 30
W. H. Brown—Settlement	2,200 00
Water Sales	7,859 66
Mint Returns—Silver	244 37
	$183,126 73

GRANBY SMELTING.

The smelting works of the Granby Company, at Grand Forks, in British Columbia, have already been described in these columns. The latest addition to these works is a converting plant, which was put in operation January 13. Previous to this the works have shipped the copper and other metals in the form of matte, but now shipments are made as blister copper, which is sent to eastern works to be refined and have the gold and silver values separated. Including the matte from the Granby furnaces with that from the Greenwood smelter and the Hall mines, it is expected that about 1,200 tons of blister copper will be shipped monthly. This will be increased to 1,500 tons when the two additional furnaces, now under construction at Grand Forks, are completed.

The converter building is a steel, fireproof structure, 160 by 68 feet, its height in the main portion being 35 feet. This building contains two stands of converters of the horizontal-barrel type. The shells are 72 inches in diameter by 100 inches in length. A 40-ton travelling crane, worked by electricity, handles the shells and matte, and a 20-ton reverberatory tilting furnace. The plant also comprises a quartz-crushing machine and grinding pan for mixing the converter linings. There are three mould carriers under each converter stand, and they are operated back and forth by a hydraulic ram.

Adjoining is the engine room, containing the blowing engine for blowing the converters, as well as the hydraulic pump that furnishes the pressure to operate the plant in the converter building. The blowing engine is run by a belt from a 200 h.p. alternating motor. It is of the power type, has an air cylinder 36 by 36 inches, and has a special unloading device attached, so that when the pressure reaches a maximum of 12 pounds the valves remain open, and no power is used when the converter is not using air.

A 10-ton travelling electric crane connects the converter building with the furnace building, 100 feet distant. The crane takes the molten matte and conveys it to the converter building, where it automatically pours the matte into the tilting reverberatory furnace. When the converter is ready for a charge the 40-ton crane places a large matte ladle in front of this furnace and by hydraulic power the furnace is tilted until there is enough for a charge.

The large crane then transfers this hot matte to the converter, into which it is poured. The converter is thereupon turned into an upright position, and the blast turned on. The blast pressure is 10 pounds per square inch, and it is maintained until such time as sufficient slag has formed. Then the blast is turned off and the slag skimmed into a large ladle. This ladle is then carried by a crane, and the slag is poured hot into a tilting furnace. The converter is next blown for a short time, when the matte is converted into metallic copper, still retaining its gold and silver values.

The moulds on the carriages are now brought into position by the hydraulic ram, and the copper is slowly poured out of the converter into the moulds. The converter is now ready for another charge.

The time occupied in converting a charge into metallic copper varies from 2 to 4 hours, depending upon the grade of copper matte. This process effects a saving of 50 per cent. in the weight of metal that has to be shipped to the refinery. Each member of the set of converters has a capacity of from 50 to 70 tons of matte daily.

The plant in the power house has been increased by a 250-h.p. horizontal turbine waterwheel and a 250-h.p. electric generator, directly connected with the waterwheel.

For the purpose of supplying water to granulate the slag, there have also been installed two additional triplex power pumps, each with a capacity of 750,000 gallons daily.

The construction and installation have been under special charge of Superintendent A. B. W. Hodges, to whom credit is due for many details of the plant, as well as its general design.

WHITEWATER MINES.

The annual general meeting of the Whitewater Mines, Limited, was held in London, on December 9th, Mr. H. W. Forster, M.P., (chairman of the company) presiding.

The Secretary (Mr. E. R. Tasman) having read the notice convening the meeting and also the auditors' report.

The Chairman said: I will first deal with the accounts, and the principal item I am sure you will recognise is the item of profit for the year. This profit appears at £3,939 8s. 8d., of which the dividend declared on December 11 last absorbed £3,125, leaving a balance of £814 8s. 8d., to be carried forward. It is only right that I should explain to you that this profit was arrived at after treating the accounts in the most drastic manner; for not only does this profit represent the revenue for only ten months, but it is arrived at after deducting from the year's work £2,623 5s. 10d. brought forward from the development account of the previous year, charging the whole of the costs of development for 1900 (less £1,000 carried forward) amounting to £3,987, and depreciation amounting to £701 1s. 1d. In other words the operating profit for the year 1900 has been debited in the accounts before you with a total amount of £7,221 6s. 11d., after which deduction a profit of £3,939 8s. 8d. still remains. From this explanation you will see that the work done during 1900 was considerably more profitable than the accounts now before you would seem to show. The amount expended upon development—that is to say, in driving tunnels for opening up further ore reserves and other work of a similar character—amounted during the year to £4,897, the advantage of which is explained by there being, at the end of 1900, 40,500 tons of ore opened up, which Mr. Fowler (our engineer) estimates at a gross value of over £50,000. Against this large value in ore reserves only £1,000 has been carried forward, and here again I am sure you must agree with me that the accounts have been treated in the most conservative possible manner. The general expenditure in British Columbia may appear to be somewhat high; but upon investigation you will find that this is really not the case, as under the item of management, office and engineering expenses are included the salaries of the mining superintendent and his clerk. The other items under this head need no further comment from me, they being for the most part payments over which we have no control. The amount of general expenditure in London cannot be considered high, and were it not that your directors are in a position to deal with such matters themselves this item wold have to be swelled to the extent of the cost of employing engineers to advise them at this end.

I may explain to you that the Whitewater vein is one which varies considerably in value, consisting as it does of bodies of high-grade ore embedded in other ore of a lower grade, and consequently the future of the mine depends upon the proportion in which the high-grade bodies of ore stand to the poorer quality around it. From Mr. Fowler's report you will notice the remarkable fact, that although the average gross value of the ore mined and treated last year was only $6.68 per ton, a profit of nearly 67 cents per ton was derived from it. This will show you how economically the mine is being worked, and the immense possibilities which would arise from any increase in the value of the ore, as the expense of attending the mining and treatment of the low-grade ore is practically the same as it would be for the higher-grade material. Mr. Fowler's figures explain that the cost of mining and treating the ore has been reduced to a minimum, and I can assure you that your directors have been careful to institute economies in every possible quarter, and with this in view I may say that our patrons, the London and British Columbia Goldfields, Limited, are assisting us in every way. At the end o last year your directors had hoped that the mine had entered on a dividend-paying basis, with every prospect of its continuance. It was therefore with considerable consternation that we were met with the decision of the American smelter people to cease taking lead ores from British Columbia except upon exorbitant terms. We thought, however, that this condition of things would be of short duration, and consequently, continued full operations at the mine and mill until March last, when the mill was shut down and work confined to development only. In April all hands were discharged except the small force necessary for keeping the workings in good order, and it was not until July last that we succeeded in making terms with a local smelter for the treatment of our ore, which terms Mr. Fowler describes as more favourable than those we had been having from the American smelter. Operations were continued with one shaft until August, since when full operations have been resumed. I think also that we may look forward to considerable improvement in the smelting position, in the first place owing to the liberal action of the Dominion Government in granting a subsidy upon lead locally refined, and secondly, from the competitions of local smelters with those of the United States which is likely to follow. In fact, we understand that a local refinery will before long be established at Nelson, which place is no great distance from our mine. Our difficulty has been that there was practically no demand for the ore such as Whitewater Mine produced in Canada itself. Almost all the ore from our part of British Columbia has had to go to the United States, and we have had to take what terms the Americen smelter could give us. We hope, however, that the outcome of the establishment of a local smelter and refinery I have referred to will be to promote competition and to offer a ready market for our productions.

Before I conclude I feel I must refer to the heavy slump in the price of lead and the somewhat smaller drop in the price of silver which have occurred since last I met you. Had this not been the case, I feel sure it would have been within my power to have spoken to-day in a far brighter manner than, under the circumstances, I am able to do. You must not, however, attach too much importance to this slump in prices, because I am hopeful—and many are agreed with me—that bottom prices have been reached, and that they may take an upward turn. As we are to-day earning profits at the mine, notwithstanding the low price of our products, it will require but a very small rise in the price of lead to produce a marked imyrovement in our position. It is also quite on the cards that in working the reef between the tunnels we shall encounter larger blocks of the higher-grade ore than has recently been met with, which again would tend to increase our profit. With this in view, I do not think we need despair. Adverse circumstances have given us some ugly knocks; but they have not ruined our mine. The mine is there thoroughly equipped with efficient, up-to-date plant, and we only want a slight stroke of luck so to improve matters as to altogether alter the aspect of affairs. Our capital is not large, the administration is efficient and economical, and therefore, although our past has been somewhat clouded, we have a much brighter future before us. I might say that thé result of operations during September, which was the first month's work after the resumption, produced no profit, which was mainly due to the expenses for that month having to be debited with certain heavy insurance charges and taxes. The work during October gave a profit of $2,000, which, although small, is, I think, a sign of general improvement. I wish I could have given you a more encouraging account of the mine; but I can honestly say that I believe there is no reason why we should despair as to the future. I now beg to move: "That the report of the directors and the statement of accounts to December 31st, 1900, now submitted to the meeting, be, and the same are hereby adopted."

Mr. Oliver Wethered, who has recently returned from a visit of inspection to the company's property in British Columbia, in seconding the resolution, gave an account of his recent visit to the mines. He said that the causes that had contributed to the present unsatisfactory position were, first, that the lead ore had not been so good in value of late as it was at first; secondly, the disorganisation caused by the strike; and thirdly, the difficulty with the smelter—the most serious of all. But, as the chairman had said, this last difficulty was being got over, and with the least advance in the price of the metals, he looked forward to an improvement in profits.

The resolution was put and carried unanimously.

NEW COMPANIES.

BRITISH COLUMBIA.

Bonanza Mountain Gold Mining Co.—Incorporated 10th January, 1902. Authorized capital $1,500,000, in shares of $1.00 each.

Comox Coal Co.—Incorporated 29th Nov., 1901 Authorized capital $100,000, in shares of $1.00.

Rock Creek Consolidated Placer Mining Co., Ltd.—Incorporated 10th December, 1901. Authorized capital $7,500.00, in shares of $25.00.

Relief Gold Mining Co.—Incorporated as an extra provincial company under the laws of B. C., 30th Nov., 1901. Authorized capital $250,000, in shares of 50 cents each. Head Office in B.C.: F. H. Nettleton, Erie, B.C., Attorney.

Davenport Gold Mines, Ltd.—Incorporated 10th January, 1902. Authorized capital $100,000, in shares of five cents each.

English and French Gold Mining Co., Ltd.—Incorporated 10th Jan., 1902. Authorized capital $2,000,000, in shares of $1.00 each.

Lardeau Smelting and Refining Co. of British Columbia, Ltd.—Incorporated 13th Jan., 1902. Authorized capital $750,000, in shares of 50 cents each.

Hardie Cinnabar Mines, Ltd.—Registered in London, Jan, 27th, 1902. Authorized capital £50,000, in £1 shares. To acquire certain mineral and mining claims in British Columbia, and to carry on the business of prospectors, miners and metallurgists.

Velvet Rossland Mines, Ltd.—Registered Jan. 25, 1902. Authorized capital £200,00, in £1 shares.

ONTARIO.

Redeemer Mining and Milling Co.—Incorporated 29th Nov., 1901. Authorized capital $500,000, in shares of $100.00 each. Head office: Windsor, Ont.

Osawabik Mining Co., Ltd.—Incorporated 29th Nov., 1901. Authorized capital $2,500,000, in shares of $25.00 each. Head Office: Sault Ste. Marie, Ont.

Consolidated White Bear Mining Co., Ltd.—Licensed 29th Nov., 1901. Head Office: J. H. Starr, Secretary, Toronto, Ont.

Echo Lake Mining Co.—Licensed 5th Dec., 1901. Authorized capital, $500,000. Head office: Moses McFadden, Solicitor, Sault Ste. Marie, Ont.

Canadian Steel and Wire Co., Ltd.—Incorporated 21st Dec., 1901. Authorized capital $200,000, in shares of $100.00 each. Head office: Hamilton, Ont.

Durham Natural Gas and Oil Co., Ltd.—Incorporated 20th Dec., 1901. Authorized capital $10,000, in shares of $10.00. Head office: Durham, Ont.

United States Gold Mining Co.—Licensed 20th Dec., 1901. Authorized capital, $100,000. Head office in Ontario: Wm. McBrady, Barrister, Port Arthur, Ont.

Consolidated Copper Co. of Parry Sound, Ltd.—Incorporated 7th Feb., 1902. Authorized capital $5,000,000, in shares of $1.00 each. Head office: Parry Sound, Ont.

Sault Gray Copper Co., Ltd.—Incorporated 28th Jan., 1902. Authorized capital $400,000, in shares of $5.00 each. Head office: Sault Ste. Marie, Ont.

Tyee Copper.—The secretary issues the following:—"The main shaft has been sunk down to the 300 ft. level, and a cross-cut north from it has struck solid ore at 75 ft. in, and crosscutting is being continued in ore-bearing formation. On the 100 ft. level, where the large ore body was first struck, a cable has been received announcing that the east drift has been driven 145 ft. from main shaft, in solid ore, and that the west drive is also being continued in solid ore. Developments of a most hopeful nature have been begun on the newly-acquired claims."

Hastings (B. C.) Exploration Syndicate.—The directors have declared an interim dividend of 5 per cent. payable March 1st.

WANTED
FOR A LIBRARY.

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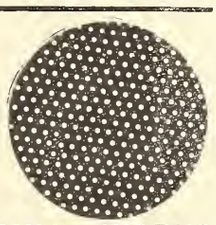
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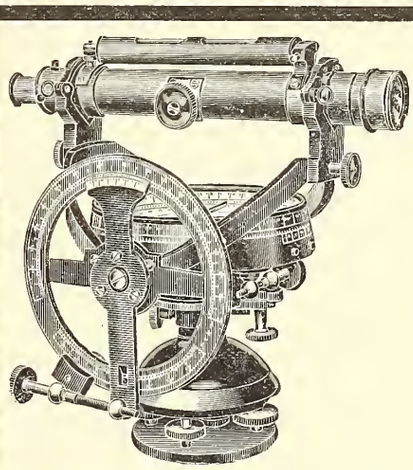
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THE GENERAL MINING ASSOCIATION OF THE PROVINCE OF QUEBEC ORGANISED 1898

General Mining Association of the Province of Quebec.

The Annual General Meeting of the Association will be held in the Library of The Canadian Mining Institute, Room IV., Windsor Hotel, Montreal, on Wednesday, 5th March, 1902, at twelve o'clock, noon.

G. E. DRUMMOND, *President.* B. T. A. BELL, *Secretary.*



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3—Courses in Chemistry, Assaying, Mineralogy,

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For further information see the Calendar of Queen's University.

4—Post-Graduate Course for the Degree of

Doctor of Science (D.Sc.)
For further information see the calendar of Queen's University.

Next Session begins October 3rd,

. . . 1900 . . .

Matriculation Examination held at Queen's University, Sept. 20th.
Unmatriculated Students admitted to Special Courses.

The School is provided with well equipped Laboratories for the study of Chemical Analysis, Assaying, Blowpiping, Mineralogy, Petrography and Drawing. In the Mining Laboratory the operations of Crushing, Amalgamating, Concentrating, Chlorinating, Cyaniding, etc., can be studied on a large scale.

FOR CALENDAR OF THE SCHOOL AND FURTHER INFORMATION APPLY TO

Dr. W. L. GOODWIN,

DIRECTOR

SCHOOL OF MINING, KINGSTON, ONTARIO.

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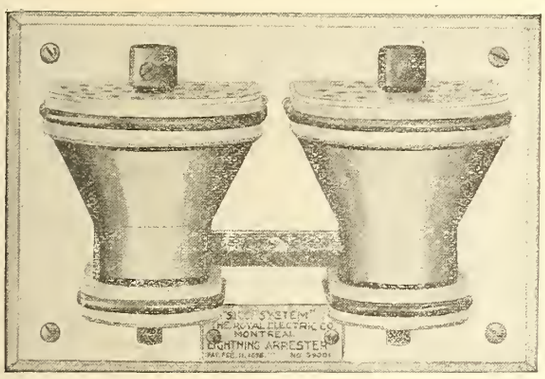
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CANADIAN MINING INSTITUTE

ANNUAL MEETINGS.

The ANNUAL GENERAL MEETINGS of the MEMBERS of THE CANADIAN MINING INSTITUTE, for the Transaction of Business, the Discussion of Papers, etc., will be held in the

CLUB ROOM, WINDSOR HOTEL, MONTREAL,

On Tuesday, Wednesday and Thursday, 4th, 5th and 6th March, 1902.

SINGLE FARE ON RAILWAYS.

Arrangements are being made whereby Members will be carried to Montreal and returned for a **Single Fare** on the Canadian Pacific, Grand Trunk, Intercolonial, Quebec Central, and Canada Atlantic Railways.

SPECIAL TOPICS FOR DISCUSSION.

In addition to a record programme of papers to be presented by the most eminent mining authorities in Canada, the following Topics have been slated by the Council for special discussion :—

GOVERNMENT AID TO MINING.
By Mr. JOHN E. HARDMAN, S.B., M.A.E., Montreal, Que.

COMPRESSED AIR.
By Mr. W. L. SANDERS, New York, N.Y.

COLLIERY VENTILATION.
By Mr. CHARLES FERGIE, M.E., Westville. N.S.

POWER DRILLS.
By Mr. C. C. HANSEN, Montreal, Que.

HAULAGE.
By Mr. WM. BLAKEMORE, M.E., Montreal, Que.

PUMPING.
By Mr. JOHN P. NORTHEY, Toronto, Ont.

Syllabus of papers and detailed programme of arrangements will be sent to members in due course.

CHARLES FERGIE, *President.* B. T. A. BELL, *Secretary.*

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OTTAWA, CANADA.



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—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of Chap. 1. Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always sta'ed that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH.

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

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The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at the mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order in Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's Certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end on the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 an acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee $5.00 renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed in the river below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent. on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River and Hill Claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer Claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim, and each person in his or its employment, except house servants, must hold a Free Miner's Certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of five per cent charged on the gross output of the claim, with the exception of an annual exemption of $5,000.00.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek or gulch, but the same miner may hold any number of claims by purchase, and Free Miners, not exceeding ten in number, may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch or river, by giving notice and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00 and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette.*

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, and a royalty of five per cent. on the gross output, less an annual exemption of $25,000.00 are charged. Operations must be commenced within one year from the date of the lease, and not less than $5,000 must be expended annually. The lease excludes all base metals, quartz and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite : copper in sulphide and native form ; gold, mostly in free milling quartz ; silver, native and sulphides ; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

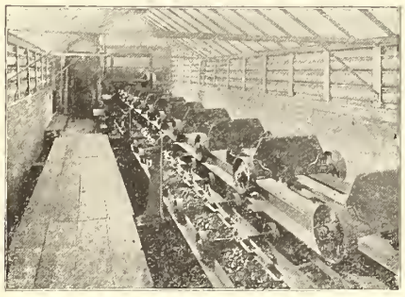
For reports of the Bureau of Mines, maps, mining laws, etc., apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

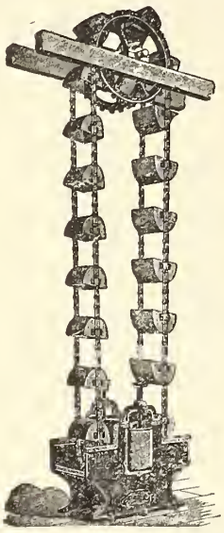
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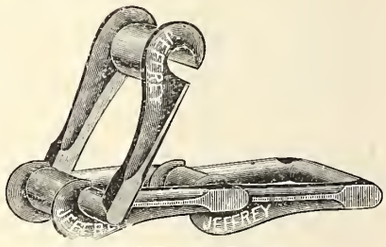


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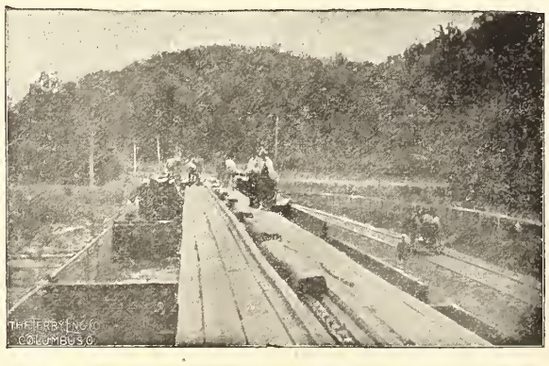
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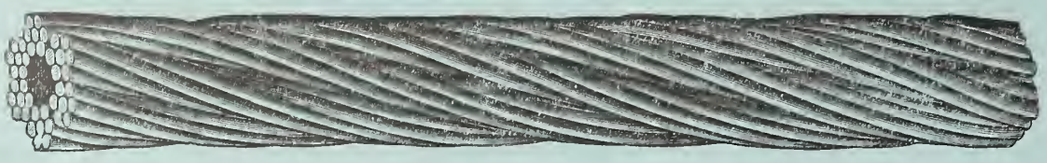
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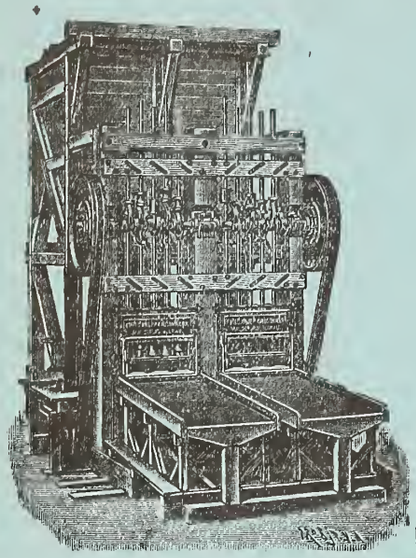
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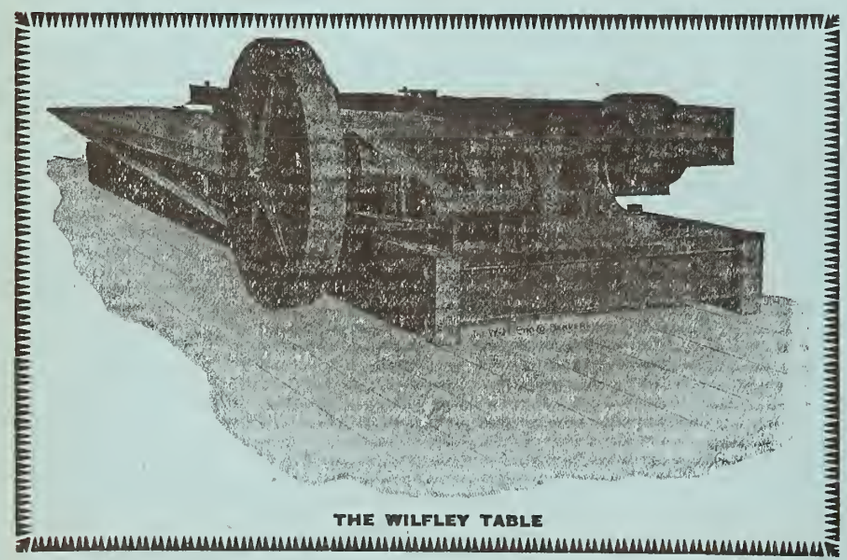
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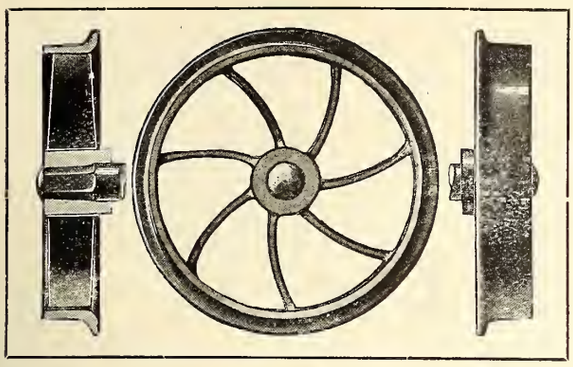
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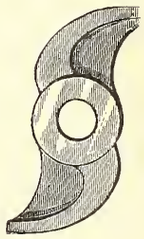




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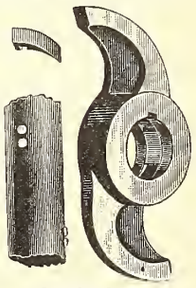


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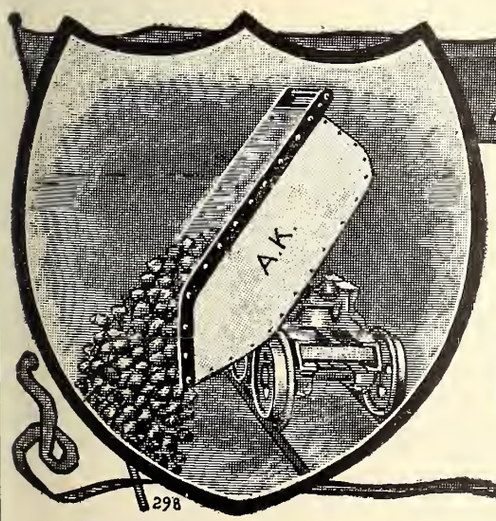


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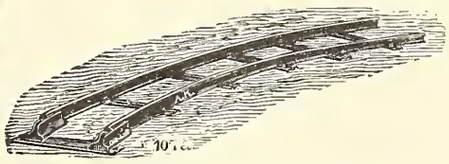
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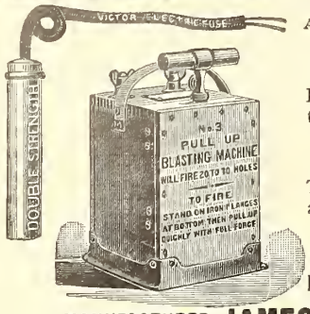
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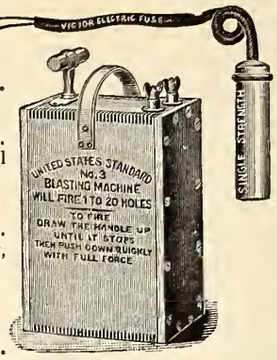
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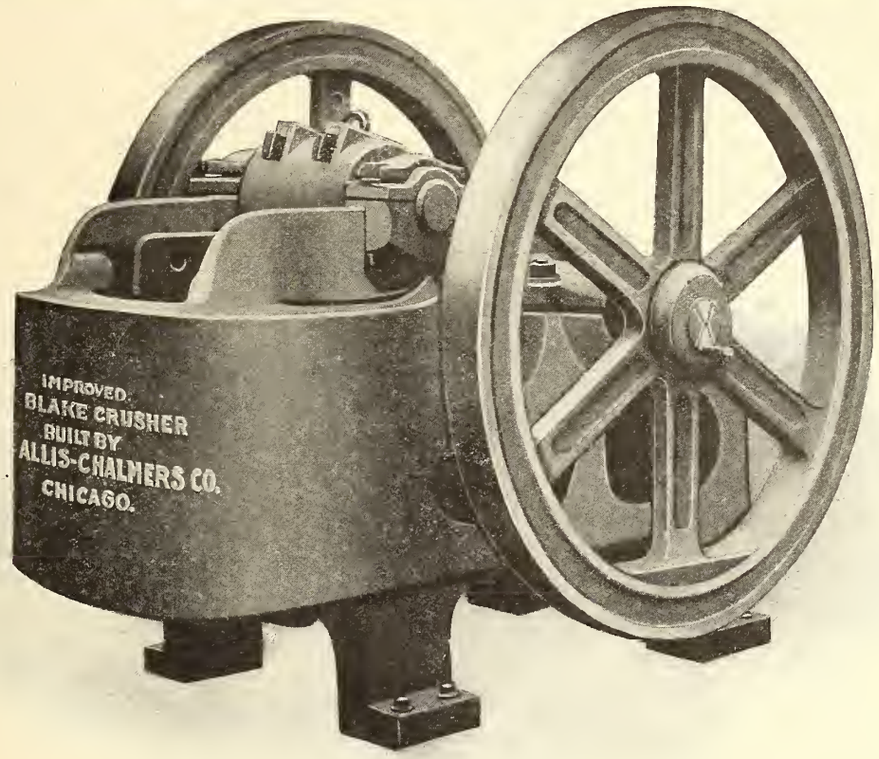
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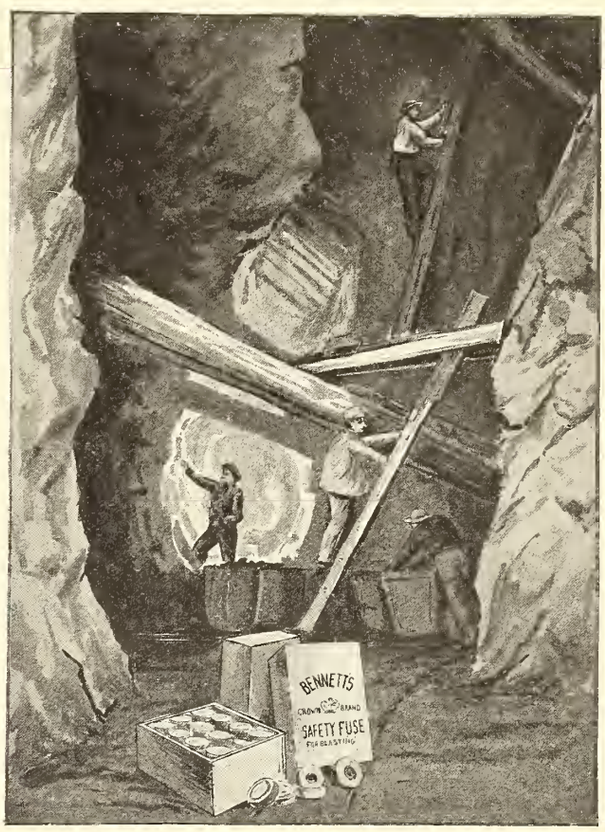
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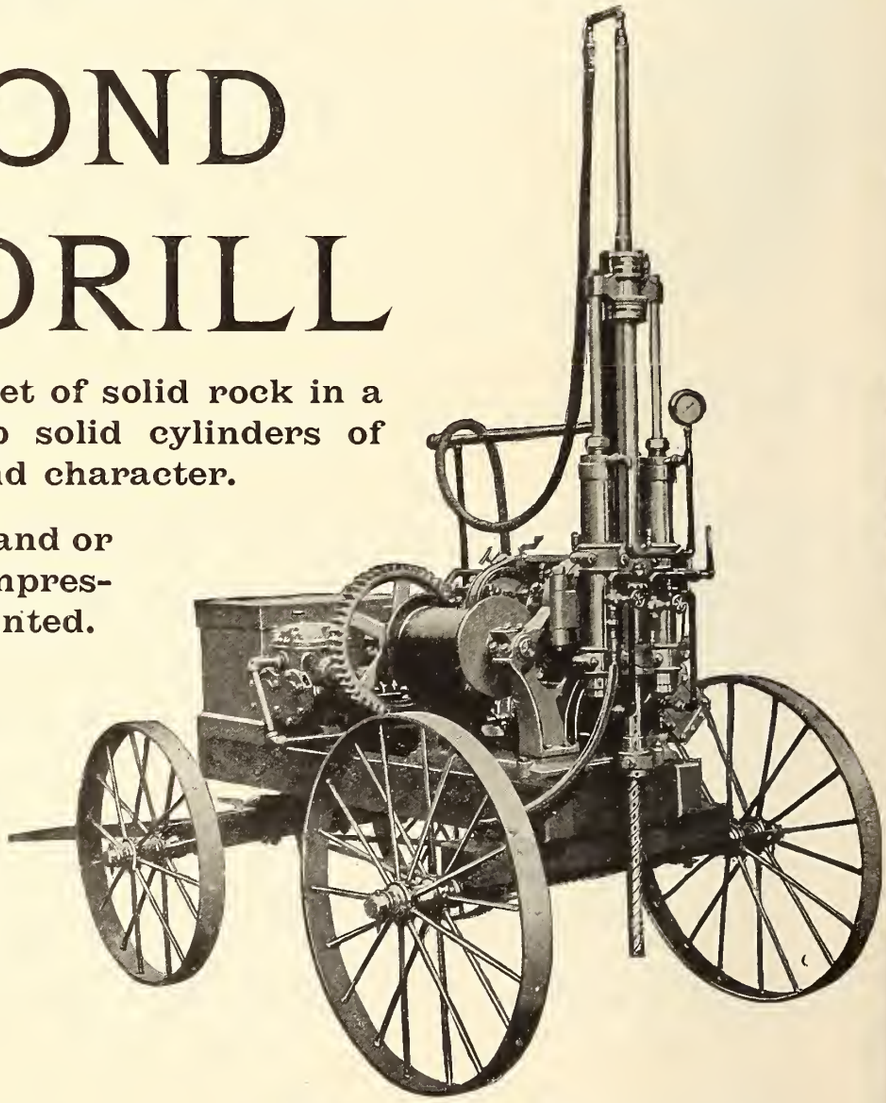
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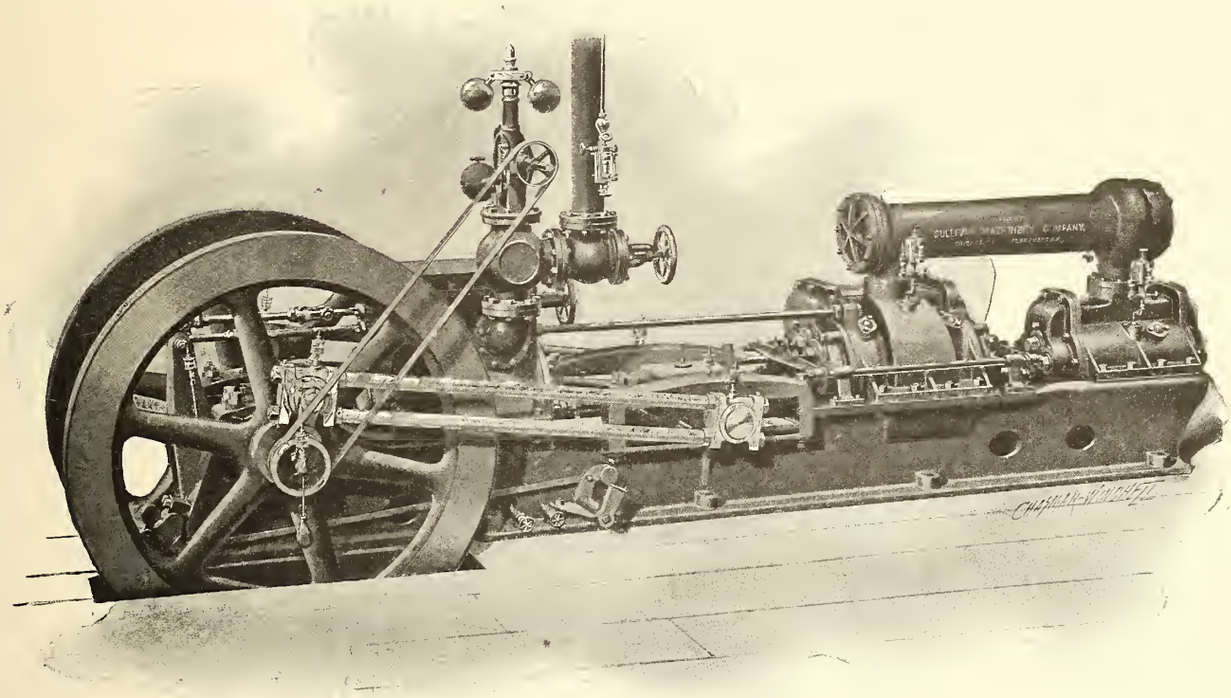
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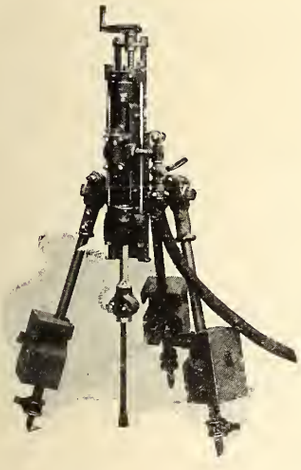
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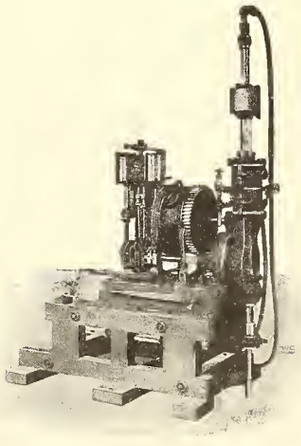


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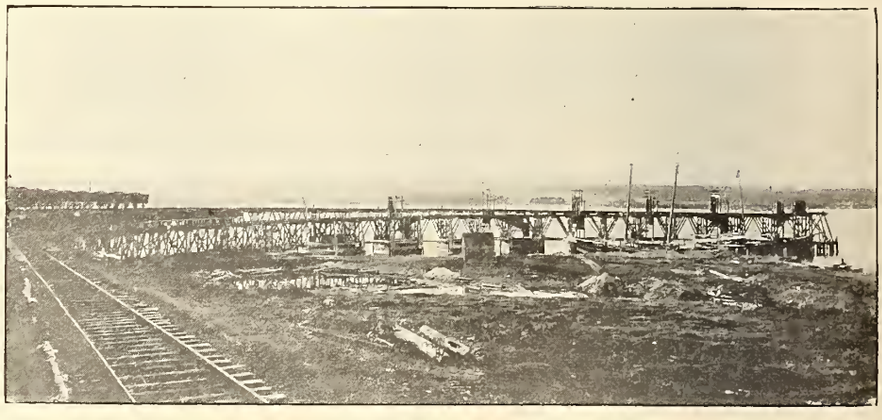
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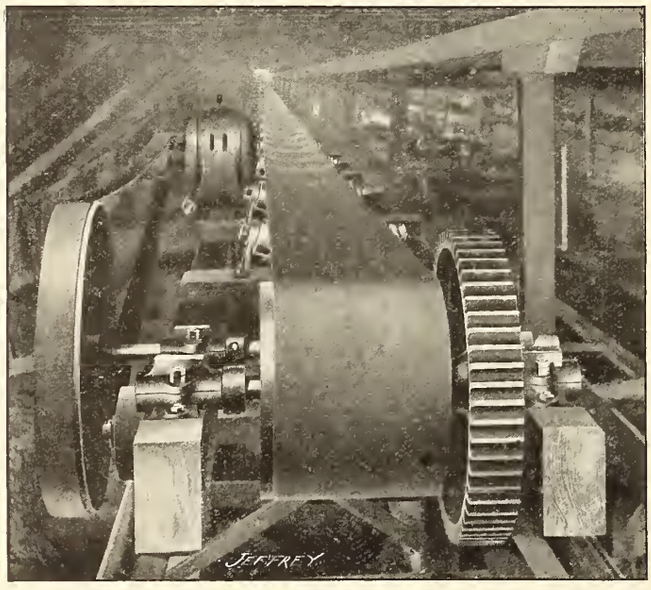
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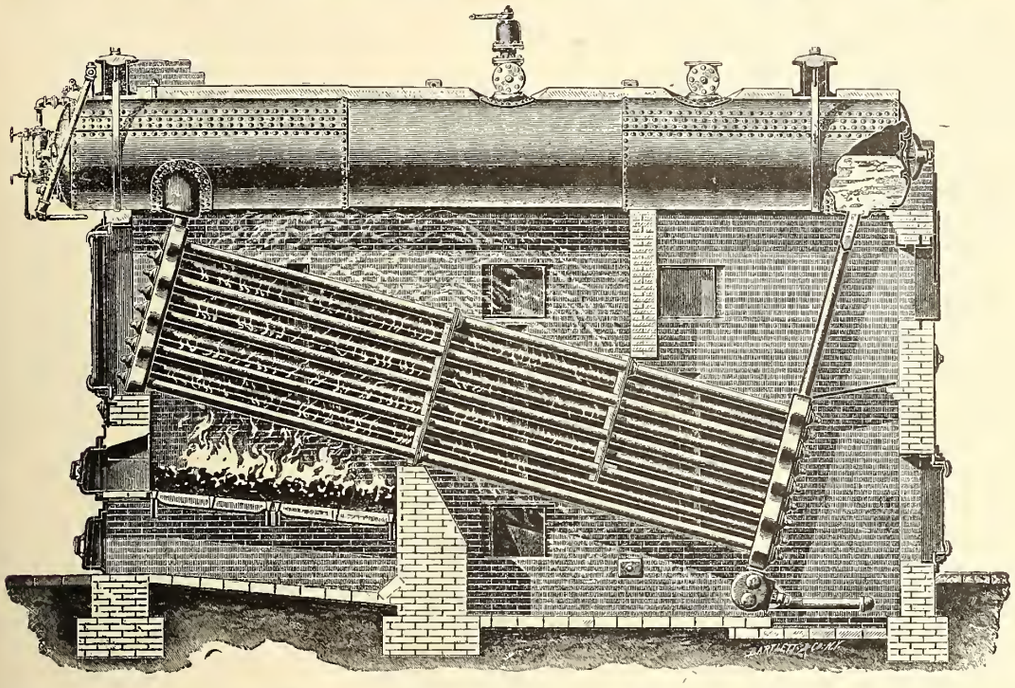
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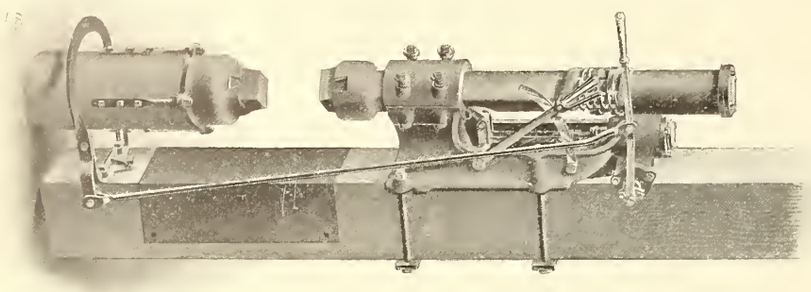
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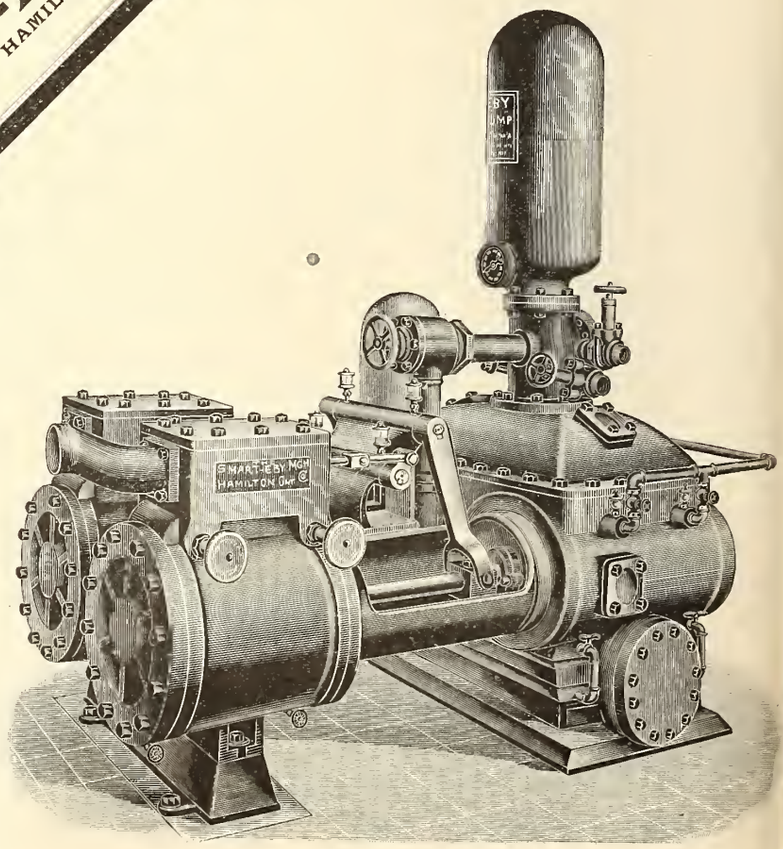


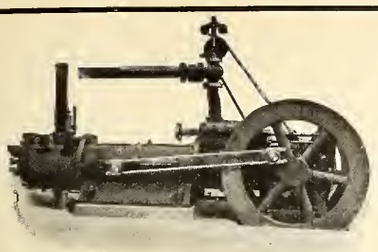
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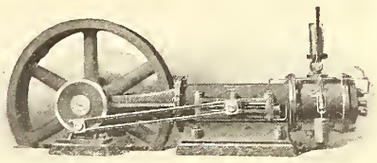
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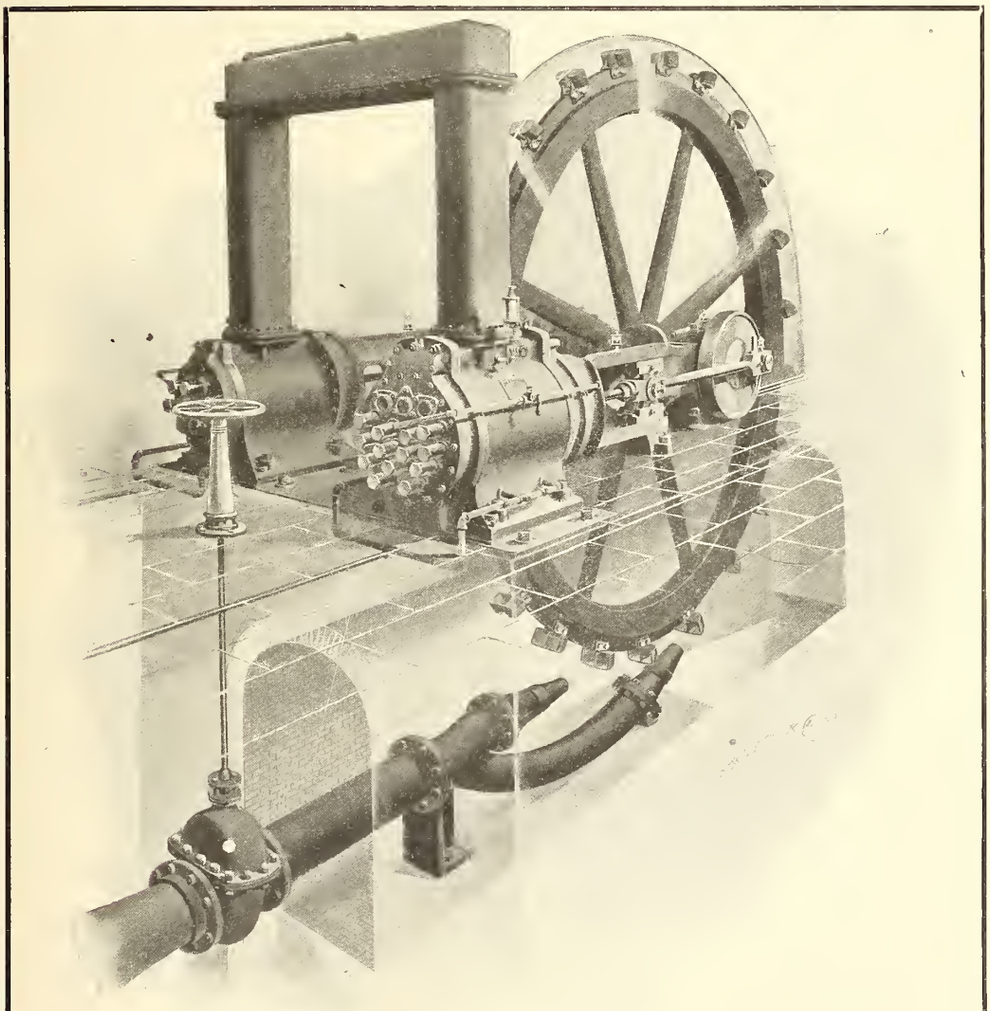
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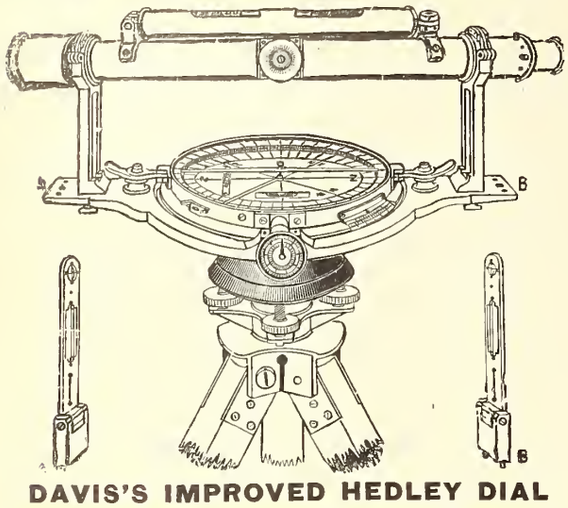
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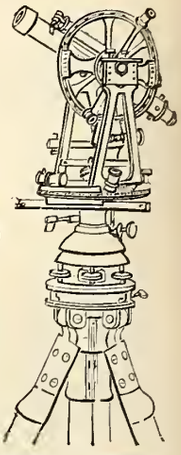
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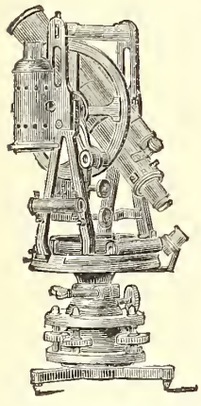
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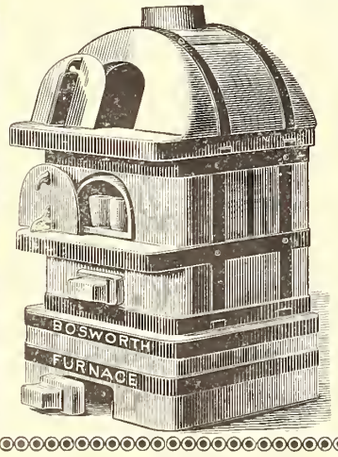
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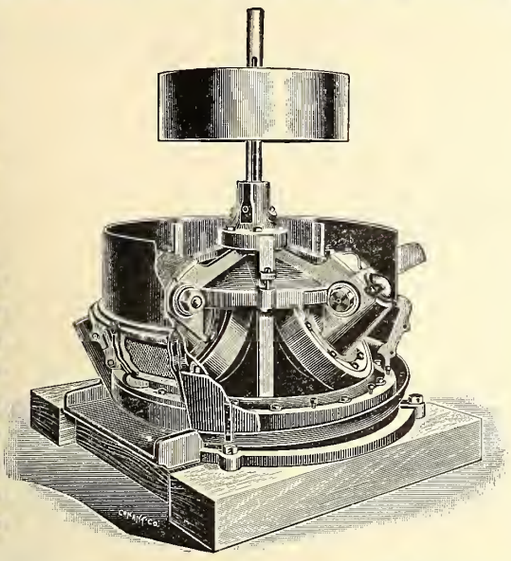
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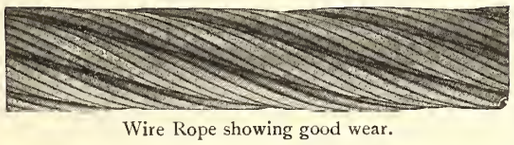
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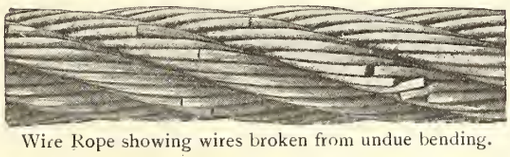
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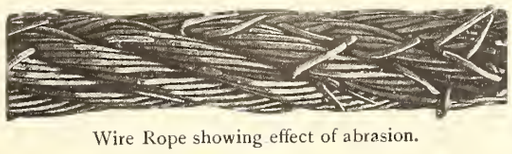
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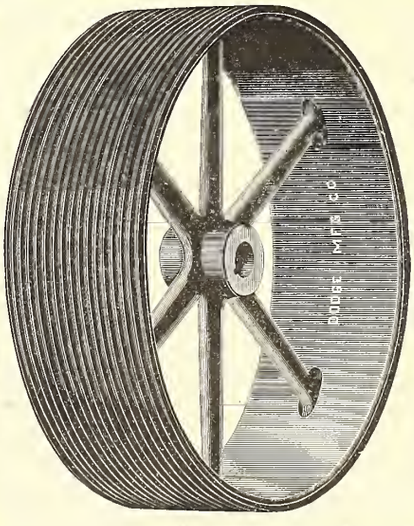
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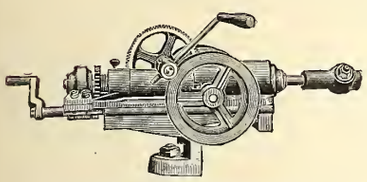
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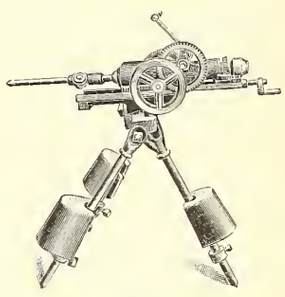
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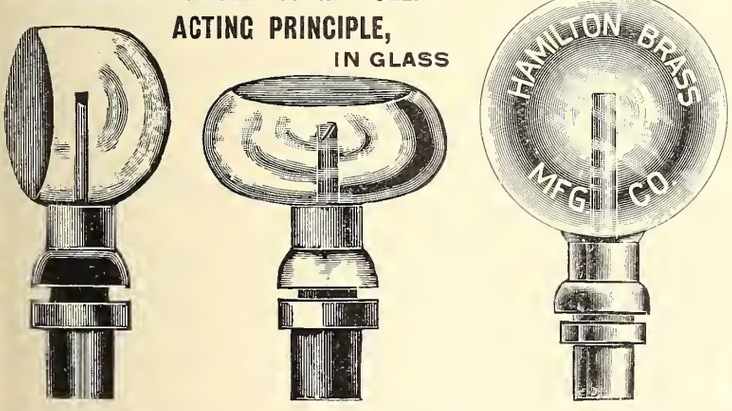


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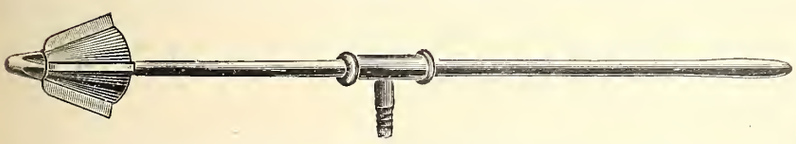
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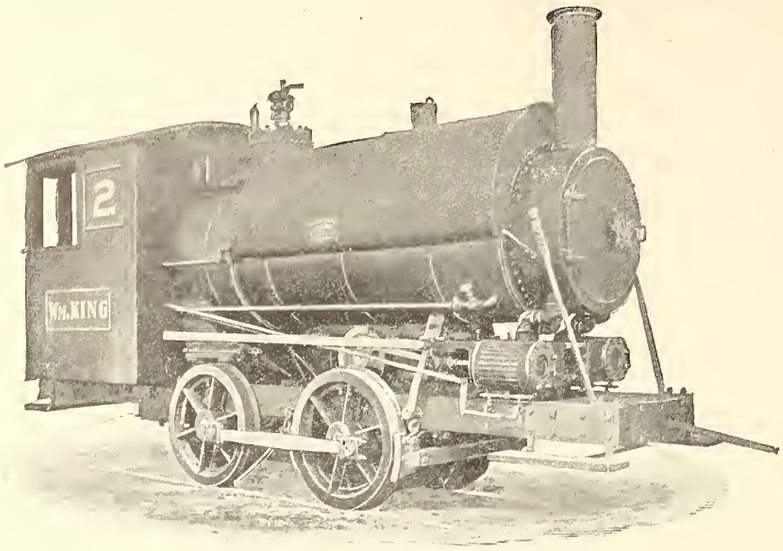
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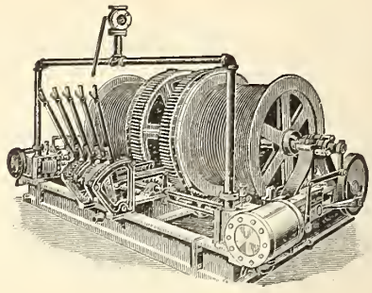
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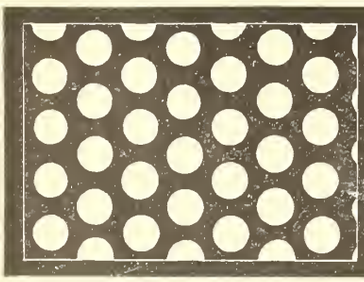
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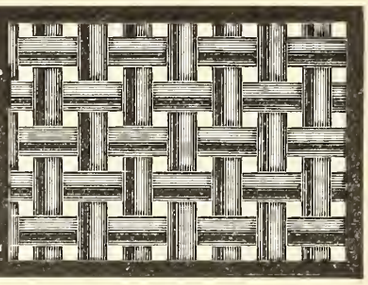


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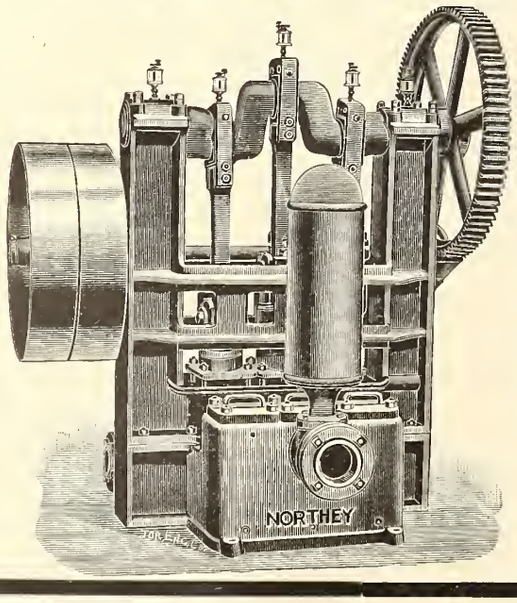
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VOL. XXI., No. 3. MARCH, 1902. VOL. XXI., No. 3.

Dominion Coal and Dominion Iron and Steel.

The heavy dealings during the past two or three months on the stock markets of Montreal, Toronto and Boston, in the securities of the Dominion Coal Co., and of the Dominion Iron and Steel Co , and the sensational advance in the Common Stock of the former company, whereby, in this short period its value has been enhanced to the extent of some nine million dollars, have caused increased attention to be turned to that remote corner of our Dominion, where on the rocky sea-girt shores of Cape Breton Island one great industry has, after many years of gradual steady growth, attained that importance which the splendid natural advantages of the country have always assured to it as an ultimate certainty, and where a second and kindred industry, carrying with it perhaps even greater possibilities of commercial success, is slowly but surely reaching that stage of development at which its promoters can plume themselves upon having successfully accomplished what they started out to do viz: to demonstrate that iron and steel can be manufactured in Cape Breton of a quality and at a cost which will meet and overcome competition from any of the great iron and steel producing centres of the United States. We hesitate, however, to say that there is anything in the present aspect of the affairs of either company, healthy and hopeful as these undoubtedly are, to justify such prices as are being paid for their common stocks. The values these have reached appear to be the result of a speculative mania that has become epidemic in certain quarters rather than to be based upon a cool and calculating survey of the situation and we should say that there is bound to be a reaction from the present period of inflation.

The coal company has just closed what, without doubt, has been the most successful year in its history, and the investing public has abundant confidence in the present management to conduct the business of the company shrewdly and wisely. In addition to holding and adding to its trade on this side of the Atlantic, the company has effected an entrance this winter into European markets and has thus shown that the increased output which will follow upon the developments now going on, can be disposed of. Leaving the much discussed Everett contract aside, the American market cannot be anything but an uncertain factor so long as the present duty of sixty-seven cents per ton is maintained. Geographically a natural market for Provincial coal, as New England assuredly is, this duty stands in the way of any steady business, and it is only when one of the pinches that the U. S. coal trade is liable to (arising from a strike, car shortage or some similar trouble) occurs that Nova Scotia coal can find its way to Boston and neighboring ports. Such an opportunity, having as its origin a severe car shortage, has occurred this winter and has afforded the Dominion Coal Co., a very convenient outlet for its coal during the months when the St. Lawrence is closed to it.

A comparative table of the shipments over the past four years will show the growth of the Company's business:

1898-9	1,145,865	tons
1899-1900	1,661,706	"
1900-1	1,957,300	"
1901-2	2,412,525	"

This current year the shipments are confidently expected to reach three million tons and the Canadian market at least is in a condition to encourage such an estimate. The Dominion Iron and Steel Company will likewise be larger consumers as their business increases. But it must be remembered that the contracts with this Company and with the New England Gas and Coke Co , were made at very low prices—particularly the last named one, which Mr. James Ross is said to be making efforts to get cancelled. Seeing that these two concerns between them can take care of about half of the total output, the prices obtained from them must lower very appreciably the average profit per ton on the coal mined. At the price at which coal is selling at present however and in the face of these two contracts, the Dominion Coal Co. should, on a shipment of three million tons, earn enough money to pay a handsome dividend on the common stock, after taking care of its fixed charges. But, while holding this sanguine view, we must maintain that in view of the many and almost unavoidable risks that a mining corporation is liable to, there is nothing in the present situation to justify such a figure as 119 for its common stock, and this quotation must be taken rather as evidence of a struggle for control between rival factions, or of a purely speculative epidemic, rather than of present intrinsic value. Meantime every confidence is felt locally and abroad in the ability of the present general manager, Mr. Cornelius Shields, to carry the affairs of the Company steadily along the path of success, and an abiding trust in the guiding hand of Mr. James Ross at the helm has, we believe, been as potent a factor as anything else among Canadian investors in bringing about what many consider the present fictitious value of the stock.

It must be remembered that the Dominion Coal Co. has sources of profit other than its coal, in its stores and in operating the forty miles of railway between Sydney and Louisburg, to say nothing of its fleet of steamers. We have always understood that the various mines' stores, while paying a good percentage upon the large amount of capital tied up in them, are run more in the interest of the employees of

the company with a view of furnishing a constant supply of good provisions and other necessaries, rather than as a merely money making venture. It is rather a favorite pastime in some quarters to abuse and hold up to execration what are termed the "pluck me's", but we feel sure that any legislation directed against such stores as are run by the Dominion Coal Co. would be inimical to the best interests of the workmen. Judging from official returns the operation of the company's railway must be very profitable. From recent reports we presume that the present passenger traffic between Sydney and Glace Bay *via* the interlying mines will cease with the inauguration of the electric railway which is about to be built along the roadbed of the old Reserve narrow gauge railway. It will be remembered that last year the Cape Breton Electric Company (or the well-known Boston firm of Stone & Webster figuring under a provincial charter) obtained franchises in the County of Cape Breton for building an electric tramway in Sydney and connecting it with Glace Bay and the mining districts. The Dominion Coal Co., seeing its railway business threatened, countered this scheme with a declaration of its intention to also build an electric railway along its old Reserve narrow gauge roadbed. A struggle was averted and a compromise arrived at whereby a third corporation was formed, controlled in equal proportions by the Dominion Coal Co., and the Cape Breton Electric Co., and the coming summer will see Glace Bay and the surrounding mining district connected with the Shire town by the inevitable trolley of modern civilization. Hardby at his Glace Bay station, Marconi will be receiving and sending wireless messages to and from Penzance and it will be left for Mons. Santos-Dumont to come over and establish a line of airships to take care of the smuggling trade between Cape Breton and St. Pierre.

The success of the Dominion Iron and Steel Co., from the standpoint of an outsider, appears to be still in a more or less problematical stage, but the men who are most deeply interested financially in the undertaking—and they are best qualified to speak authoritatively—have never for a moment wavered in their confidence and are as sure of ultimate success as of the daily sunrise. They are perfectly frank as to the difficulties which the company has encountered,—difficulties often unforeseen, which are incidental to the initial stages of similar enterprises of great magnitude wherever started, and they are quite sanguine as to the ability of the officials in charge to surmount them.

The past year has been one of many and somewhat dramatic changes in the *personnel* of the official staff. But despite adverse criticism and stories of extravagances and mistakes, which these changes, not unnaturally, evoked, general and individual faith in the ultimate success of the venture and in the directorate of the company, does as not appear to have been very rudely shaken. No better proof of this can be cited than the fact that the first issue of ten millions of common stock did not have the effect, which might naturally be expected, of depreciating the market value of the fifteen millions already issued, but, on the contrary, has apparently had a strengthening effect, seeing that the stock has subsequently advanced ten or twelve points. This may not be strictly a case of cause and effect, but the fact cannot be lost sight of that the common stock advanced very materially after and in spite the announcement of the new issue. The primary conditions have been proved beyond a peradventure to be as favorable as was claimed at the outset. The pig iron has found favor in many markets on both sides of the Atlantic and the steel that is now being turned out is of excellent quality. The work of construction was more protracted than we promised in the days of early enthusiasm, and difficulties have undoubtedly been met with, chiefly in connection with the working of the furnaces, that were unforeseen and that have seriously hampered operations. One of the furnaces has been laid off altogether to be relined, and it is understood that the same course will have to be followed with the other three. This, of course, curtails the output of pig very considerably, but no works can be free from difficulties of this sort, and we have been assured on the authority of those who are competent to judge, that the troubles which have occurred can and will be rectified, and that their effect can only be to retard, and in no way to jeopardise, the ultimate and complete success of this great enterprise. The steel-making end is an unqualified success and when the rail mill now in course of construction gets to work, we prophesy that the earning capabilities of the company will astonish those who now hold pessimistic views.

The most important change that has taken place during the past year in connection with the two large corporations now under notice, has been the transfer of controlling influence from American into Canadian hands and the installation of Mr. James Ross as the virtual head of both concerns. Mr. Henry M. Whitney has so far retained the presidency of both companies and maintained an interest in and a friendly attitude towards them, and we earnestly hope that he will long continue to do so. It must not for a moment be forgotten that to the genius of Mr. Whitney and to his energy and business acumen, is due the credit for the present state of activity in and around Sydney, which has brought wealth to so many and occupation to thousands. It must not be a case of "*Le Roi est mort; vive le Roi*". And, unless we have strangely erred in gauging local sentiment in this matter, the people of Nova Scotia in general and of the County of Cape Breton in particular entertain strong feelings of gratitude and of personal regard toward Mr. Whitney, not only for what he has done in developing the vast coal fields of the Island and in providing new uses and new markets for its coal, but for his friendly and generous attitude towards any movement that was calculated to bring happiness or benefit in any way to those living in and around the districts that were affected by his business operations—Cape Breton we feel sure will not be slow to pay a proper tribute of gratitude to Mr. Whitney for all that she has gained during the past nine years through his exploitation of her resources.

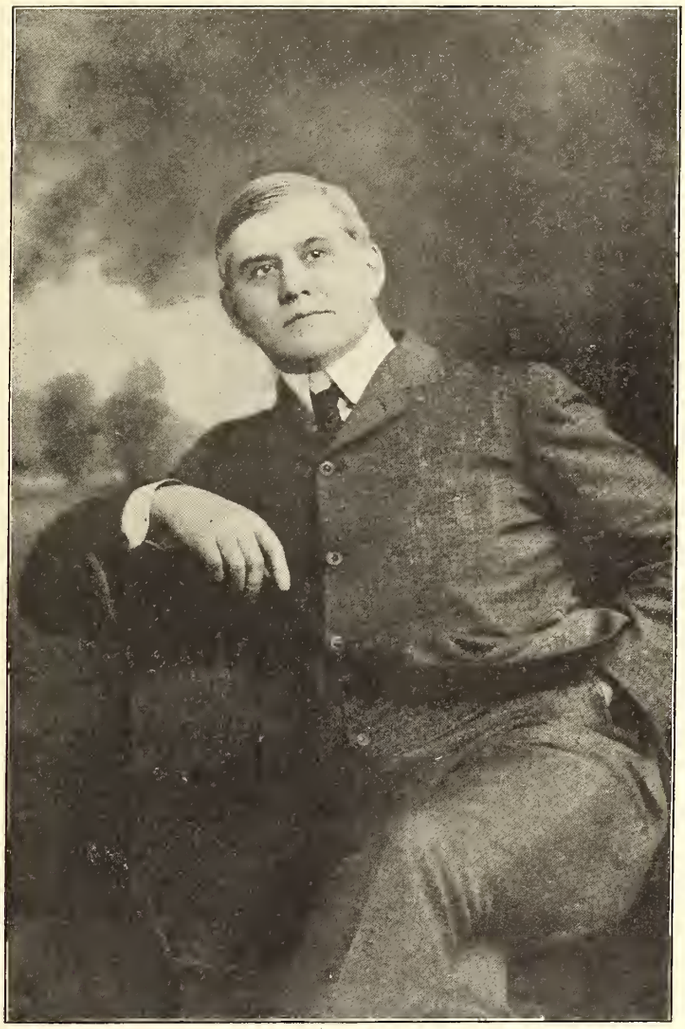
The Interior British Columbia Mineral Field

The approximate and advance estimate, for 1901, of the mineral production, including coal, of British Columbia as made by the Provincial Mineralogist is 871,832 tons mined, value $20,713,501. Compared with the previous year 554,796 tons mined, value $16,344,751. There is a considerable advance and this advance has been made under many draw backs.

These disadvantages appear to have been exaggerated or at least aggravated by adverse opinions of the country widely published. Mining stocks are low and money for investment in mines is not at all free, but, *bona fide* mining is more prevalent than heretofore even under the real disadvantages of costly operation and low price of metals.

Under the low prices of Lead, Silver and Copper, at the present time, there is still an increasing production. The development of the past year has been quite favorable. The average grade of ore is lowering steadily along with a lowering in costs of production or treatment. This is a natural consequence and increases tonnage and industry all round. The deeper levels of the mines show, on the whole, no loss of values, in several instances quite the reverse.

The average value of these 871,832 tons of ore mined in 1901 is nearly $24.00 a ton. It may be said this proves nothing. However it may be said also that it points to no poverty of mineral. Nearly half of that tonnage is of much lower grade and is produced and reduced at a cost said to be as low as any on the continent. We may



MR. CORNELIUS SHIELDS, SYDNEY, C.B.

Vice-President and General Manager,
Dominion Coal Co. Limited.

also hope for a less cost of production and treatment for much of the other half as things go on. To some extent the following estimates of the average local value of the ores mined will illustrate the costs of their production. These estimates may be derived directly from the tonnage and values given in the advance report of the Provincial Mineralogist excepting East Kootenay and the Coast mines.

LOCALITY.	METALS.	TONNAGE.	AV. VALUE PER TON.
East Kootenay.....	Silver and Lead.	26,536	$20 to $25
Nelson.....	Gold, Silver and Copper.	103,486	10.72
Slocan and Ainsworth...	Silver and Lead.	30,267	74.00
Lardeau and others.....	Silver and Lead.	1,229	127.00
Rossland (Trail)	Gold and Copper.	279,084	13.81
Boundary & Kettle River	Gold and Copper.	401,008	11.71
Coast Mines.....	Gold and Copper.	23,394	$20 to $25

This classification holds fairly well for the principal tonnage of each of the above localities, districts or divisions. However, the value per ton of the output of the larger mines in each division is somewhat lower than this general average. The general average being apparently raised by a smaller tonnage of higher grade ore. The camps which have the highest values per ton have correspondingly high costs of production and treatment. As time goes on these costs will be reduced and a greater tonnage of lower grade be produced.

The value $14,250,541 estimated as the production of *lode* mining, comes from that transverse section of British Columbia which lies between the main C.P.R. line and the U. S. boundary. West of the Kootenay—Columbia valley to the Coast.

Leaving out the Coast production of about $250,000 the rest comes from the interior strip east of the coast ranges. An area of about 125 miles north and south by 200 miles east and west. Twelve years ago this district itself was not known to be widely mineralized with metallic ores. It was in much the same condition as Cariboo, Omenica, and Cassiar at this present time, but was more accessible. It had been traversed and nearly worked out as a placer district. The old Dewdney trail crossed it and passed close by some of the present mines, on its way to the Wild Horse placers.

The interior strips of British Columbia lying between the great valley west of the Rockies and the Granite Coast Ranges continues N.N.W. with great similiarity of topography and geological conditions right up to the Yukon Country.

Dr. Dawson on page 28 of his 1887 Yukon Report says of this persistency of similar rock series, in that district :—

"Speaking broadly, however, and with reference to the general features of the region, the rock series represented are evidently similiar to those found in the southern portion of British Columbia, between the Rocky Mountains and the Coast, and an important general result of the work here reported on, is the further demonstration of the great constancy in lithological characters of the several formations, when following in the direction of the main north-west and south-east axes of uplift. A constancy which contrasts materially with the diversity found when conparisons are made as between localities situated at right angles to that direction."

It is reasonable to suppose that this mountain region already proved to be a great mineral bearer in the United States, and Southern British Columbia, will continue the same to the northwards especially with rocks so similar and so similiarly affected by geological conditions.

Whatever may be its mineral wealth, it's extent is very great. A strip about 1300 miles long from the U. S. boundary to Alaska, and 150 to 200 miles broad, from the Rockies to the Coast Ranges. Within this great tract of country are the Placer gold fields of Upper Fraser river, Old Cariboo, Omenica, Cassiar, Stikine, Dease and Atlin, and the Yukon, already discovered and only worked partially and to a certain grade of richness governed by the costs of these remote places. At the present time possibly no lode mining camps of equal richness to those of Southern Kootenay may be discovered and opened up as time goes on, but this great district looks as well favored in that respect as Southern Kootenay did at the time it was a placer district, and nothing more, a few years ago.

Concerning the distribution of lode minerals as observed without close prospecting, Dr. Dawson mentions the presence of galena carrying 75 ounces of silver to the ton on McDane Creek in Cassiar. Mr. McConnell writes of "large veins of highly argentiferous galena in Omenica. The geological conditions of these districts are said to be favorable to the production of ore bodies.

In the district which lies north of Revelstoke and Kamloops, many bodies of silver, lead and gold ores have been discovered. These do not appear to be exceptionally rich, but carry very fair values if made easily accessible. North of this and east of the great valley is the mica-bearing formation already shown to carry valuable mica over a wide extent of country.

The gold quartz discoveries of Old Cariboo are usually of low grade, containing values from trace up to an ounce per ton in gold. Values of $17.03 per ton were, however, milled from the Walbur ledge in 1887.

Bridge River and the Upper Fraser river show some favorable ore bodies if operated under more accessible conditions. Some ore has also been treated in this district.

The special attention given to placer mining in the northern portion of British Columbia and the Yukon, during the past five years has resulted in discoveries of large ore-bodies in Atlin, White Horse and Rainy Hollow. These do not appear to be of high grade, but they show the mineral capacity of the country, and the present operation of two stamp mills. The Ladue and Munger mills near Dawson, show that lode mining is going on at the other end of this 1300 mile stretch of the mineral belt of B.C. and the Yukon.

With present conditions of costly prospecting and transportation this great mineral reserve remains a wilderness, except for the operations of placer and hydraulic mining, but there seems little doubt that it will be traversed by railroads before very long. At least across its more southerly portion from Yellowhead Pass to a port on the Pacific Coast, north of Vancouver.

Mining Prosperity in Ontario.

The prosperity which has attended mining enterprise throughout the Dominion during the past year has been particularly noticeable to Ontario, the value of the year's output being estimated at about $12,000,000 as compared with $9,298,624 in 1900. Complete figures for the year are, of course, unobtainable at this early period of the year, but some interesting data is furnished by Mr. T. W. Gibson the Director of Mines, in a bulletin issued on 4th instant, from which we quote :—

"Almost the whole of this increase is in the products of metalliferous mines and works, the value of which is about 100 per cent. more than in the previous year. Most of the non-metallic products also show increased values, but these are largely offset by a falling off in the yield of petroleum, and a reduction in the quantity and value of petroleum products.

The chief increases are as follows:—

	Increase in quantity.		Increase in value.	
Copper.....	2,346,000 lbs., or	35 per cent.	$ 269,399 or	84 per cent.
Nickel.....	1,802,000 "	25 "	1,103,344 "	145 "
Iron Ore. .	182,236 tons	201 "	62,623 "	56 "
Pig Iron...	53,984 "	86 "	765,637 "	82 "

The principal decreases are :—

	Decrease in quantity.	Decrease in value.
Petroleum..	1,948,283 Imp. gals or 8 per cent.	$ 401,105 or 21 per cent.
Natural gas.....		56,640 " 15 "

The good demand and relatively high prices for nickel, which have prevailed for some time, are reflected in the output for 1901, the largest yet recorded. The increase in value is greater than the increase in production, for the reason that the nickel-copper matte in which the metal is contained now being produced at the Sudbury mines is of much higher grade than heretofore the same remarks apply to copper, the price of which was well maintained until about the close of the year, when it broke heavily. Part of the copper output was from the non-nickeliferous mines on the north shore of Lake Huron.

The increased production of iron ore is due to the development of the Helen mine in Michipicoten, which shipped freely during the year, both to Ontario furnaces and the United States.

The greater output of pig iron is owing to the fact that there are now three furnaces in operation as against two in 1900, the Canada Iron Furnace Company's smelter at Midland having been blown in about the end of that year. There were smelted 109,009 tons of Ontario ore and 85,399 tons imported from the United States, in all 194,408 tons; the proportion of native ore used being thus about 56 per cent.

Since the beginning of the present year steel-making, heretofore carried on at Hamilton only, has been begun at the Clergue works, Sault Ste. Marie.

In case of petroleum the quantity given is the number of gallons of crude output, while the value is that of illuminating oil and other products of refinement, and in addition the value of the crude used as such for fuel and gas-making purposes, which absorbed about 15 per cent. of the yield.

The action of the government in stopping the export of natural gas from the Essex field to Detroit explains the diminution in value of this product.

I may point out that the values of the several products are calculated at the selling prices at the mines or works, not at the prices of the refined or finished articles. If the latter basis have been adopted, as is sometimes done, the value of the copper output for the year would have been about $1,450,000, instead of $589,080, and of nickel about $4,440,090 instead of $1,859,970; while the aggregate value of the year's production would have been increased by about $3,400,00. It is not clear, however, that this method of tabulating values is applicable to unrefined or partially treated metals which are exported for the final processes, when it would not be employed in the case of other raw or unfinished materials, and the values at the mines or works have accordingly been adhered to.

Strictly speaking, the value of the iron ore, both native and foreign, smelted into pig iron, and of the pig iron converted into steel, should be deducted from the aggregate value of the year's production; the foreign ore because it is not a product of Ontario, and the native ore and pig iron to prevent the value of these articles being reckoned twice. The items would amount to about $500,000 but it has not been thought necessary to make the deduction, and with this explanation there is no danger of the matter being misunderstood.

Arsenic, carbide of calcium and corundum are beginning to be important products. The first and last named are not mined elsewhere in Canada, arsenic not elsewhere in America."

The National Importance of Mining.

By Mr. John E. Hardman, S.B., M.A.E., Montreal.

(Introducing topic for discussion at the Annual Meetings of the Canadian Mining Institute.)

After agreeing to present or introduce this topic for discussion, I chose the title of "The National Importance of the Mining Industry" rather than "Government Aid to Mining," for the reason that I wished to emphasize the duty of the *nation*, rather than the duty of the Provinces, to encourage an industry which has grown to be of such great importance to the Dominion. In considering the discussion of provincial matters, I felt that as a "Canadian" or National "Mining Institute" we had neither a right, nor a duty, to discuss provincial matters, but that our remarks should be confined to such topics as were within the jurisdiction of the Minister of the Interior, within whose department lies the administration of all federal matters which affect the industry of mining.

After listening to the figures which the Secretary has just read to you, the *national* importance to which the industry of mining has attained is axiomatic, and needs no demonstration. A total production of over seventy millions of dollars is eloquent testimony of the importance of an industry which produces annually such a large sum, and the figures are all the apology which is needed for introducing to this Institute a discussion as to whether, and how, the federal government can best assist and promote such an industry, not only to greater dimensions, but also to greater perfection, while still preserving and maintaining fidelity to that branch of the British North America Act by which the control and administration of minerals found within the borders of any particular province was vested in that province; and in doing so the necessity for confining my remarks and suggestions entirely within the limitations imposed by the title becomes apparent. I allude, therefore, to such matters as are strictly of *national* importance as distinguished from matters which are particularly *provincial* in their sphere.

In so doing, I am quite aware, from the printed pamphlet which is before you, and from other information which I have received personally from the Secretary, that I shall have to disregard and put out of consideration many suggestion which are of great importance, but which deal almost exclusively with matters of provincial jurisdiction, and cannot, therefore, be considered in a discussion of this topic. Many of these matters are of the highest importance, and perhaps it will not be unwelcome to simply allude to them and run over them as suggestions to provincial authorities.

First, the question of transportation, and by this word transportation I do not by any means wish or desire to refer solely to long distance transmission on railways, but more particularly to the equally important question of highroad transportation, where the bulk of the material to be handled has to be transported comparatively short distances only. Such transportation necessitates good high roads with easy grades and hard roadbeds so that a maximum load may be transported at a minimum cost.

Equally, the establishment of public assay offices, the giving of grants for the maintenance, or assistance, of mining schools, the assisting of schemes for deep sinking in the shape of subsidies, the establishment of governmental custom reduction works for the experimental beneficiation of ores, or of government diamond drills for the testing of private deposits: all are topics which interested mine owners may feel called upon to consider, but which the national government cannot consider inasmuch as all revenues coming from the working of these mineral deposits would go into the provincial treasury and not into the Dominion. To this may be added government aid to hospitals and accident relief funds, and the still more important question of proper governmental inspection of existing mines and mine workings.

Likewise, the question of import duties on machinery and upon supplies used by the miner, are not within the province of this Institute; they are more strictly political matters, and as such do not come within the domain of this Institute, and must be left to the consideration of those gentlemen now in session in Ottawa, known as the Parliament of Canada.

You will see, therefore, that the subject is not a simple one, but a very complex one, and worthy of extended discussion and most minute investigation; for while Canada, as a nation, derives no direct benefit in the shape of royalties, etc., (excepting from the Yukon and North-West Territories), yet the mining industry, indirectly, is a source of great national wealth by reason of the taxes, duties, supplies bought, etc., etc., all of which contribute to the national wealth on account of the increased consumption of foreign goods in the shape of machinery and supplies, on account of the greatly increased number of manual labourers, which implies equally the increase of labor for a large portion of the population working at remunerative wages, and thereby contributing its quota to the general prosperity of the merchants and of the whole country.

Now, as to guidance as to what one may reasonably expect of the federal government in the shape of help, we must turn and consider what has been done by other governments in other parts of the world where similar deposits of mineral richness have occurred, and where similar requests for aid have been made, entertained, and (perhaps) granted. Britain's colonies, such as New South Wales, Victoria, and New Zealand, have been very generous in their efforts to aid their own mining industry, and they have given grants for many of the subjects that I have just enumerated. The older European countries cannot be looked to for examples, inasmuch as new ground and undiscovered deposits are the exception and not the rule in their domain. Perhaps one of the best hints that we can get to guide us in the consideration of this matter is given by the great commonwealth on our southern border.

And in entering upon this matter and discussing it, we cannot do better than to take our first lesson in the shape of noting that in the United States the mining division, or the Geological Survey department, is entirely and *absolutely divorced from politics* in every shape and sense of the word; neither the head nor the subordinates of any such department are political appointees, neither are they under civil service rules, but they are considered as business employees to be used just so long as they give value received for their salaries, and to be summarily dismissed when such salaries are not earned. It has seemed to me, and I invite your discussion of my reasons, that no part nor branch nor department of the federal government is so well qualified to undertake assistance to the mining industry as a properly organized and well constitued Geological Survey. I see this evening, on looking about me, many gentlemen from the national capital who have been paying extreme and minute attention to my remarks thus far, and I am glad to see these gentlemen here, and I am sorry that they are not all of them members of the Institute. There are, however, a number of them who are members, and who will probably, I am glad to say, take part in this discussion, and will tend to elucidate those matters upon which I may be more or less obscure.

The question of what is the proper and legitimate field of a Geological Survey is a legitimate one for discussion, and is not out of place under the title of "The National Importance of the Mining Industry," and it may be well, particularly before so many mining men who, in my experience, are rarely acquainted either with what the Geological Survey is actually doing or what is its proper function to do, to review briefly what a geological survey is *supposed* to do. And before starting let me say one more word, and that is that the mining industry is an industry of *facts* and of *deeds*, all the better perhaps when it is aided by sound theory, and in what I am going to say I wish to announce that I say it solely and simply from the standpoint of the practical man who *does*, and wants others to *do*, but for whom theoretical discussions have always had a great attraction and a great value, and who is very much indebted to theoretical views for the small share of success which has been his portion.

The primary work of the Survey may be considered as (1) the determination and publication of facts concerning the local distribution of rocks; in other words, what is known scientifically as "Areal" Geology; (2) the determination and publication of the general facts of the geology of a country; to arrive both at the local distribution and at the general facts as mentioned, it is necessary to provide departments for the various branches of work, and first and foremost comes in the necessity for accurate maps on which the facts of local, or general distribution, may be laid down. This is the first and essential prerequisite for the departments which follow, and I may say here that the ordinary maps provided by the various Crown Lands Departments are by no means of sufficient accuracy, or of the necessary character, to permit of geologic work being laid out upon them. The second subdivision is that of the Geological Division, in which is included Paleontology, by which the rocks are labelled, as it were, and their position on the earth's crust ascertained; third, the Petrographical with which is allied the Chemical and Physical divisions, and which are necessary to determine different rocks, and the different questions affecting those rocks as to composition and characteristics. The inter-dependence of these various branches with the more purely geologic is evident, and there must be a constant interchange between the Geological staff and the staffs of the Paleontological, Petrographical, Chemical and Physical divisions. Each of these divisions requires the supervision of an expert. But, in addition to the above departments, whose work is of interest only to a small number or fraction of the total population, there must be means of making these facts generally understandable by the public, and by that largely increasing body in Canada, the men who are directly interested in the production of metallic wealth. Without taking up your time, I may say that the other departments include the statistical work, the editorial, the supervision of illustrations, the care of the library, and the disbursements of money, with many other smaller branches, which thus create an administrative branch as well as a scientific one. In the present condition of our Dominion, as regards the fostering of the mining industry, and the equally important field of informing our citizens and the world at large of what our resources are, a distinct prominence must be given to *Economic Geology*, which, briefly described, is the practical application of geological investigation to the development of the mineral resources of a country. This division of Economic Geology is, by far, more important to Canada's citizens at the present moment than any descriptive or purely structural geology can be, although, as you will notice as this discussion proceeds, I am firmly of the opinion that no economic geology is worthy of the name unless it is preceded or accompanied by such accurate descriptive work as will fully elucidate the many problems which inevitably come up in economic work. In fact, it is not going too far to say that the lack of such proper economic geological work rendered possible to a great extent that inflation in British Columbia during the years 1896-97 which was so disastrous in its effects, and which I think I am right in saying was due more to the ignorance of the limitations of the deposits then discovered, than to the actual ignorance and incompetence which was displayed in the mining work then and afterwards.

Recognizing, therefore, the importance of this economic geology, which we may paraphrase into Mining Geology, I may say that the work of the Survey at the present time *should* be divided into (1) General Geology, and (2) Mining Geology; with the objects of providing not only the geologic map and a knowledge of areas of different formations with their structural relations, but also to provide special

information concerning our mineral resources, and definite knowledge concerning the origin, structure and relation of the ore deposits which are found in Canada.

The section of Mining Geology, or economic geology, appeals to the mining engineer, and to his clients, who are that portion of the public, native or foreign, which contemplates the development of the country's resources. The relation of the geologist to the mining engineer is a relation similar to that which the engineer holds to his clients and to the general public. The duty of the mining engineer to his employer is to place before him in intelligible shape the character, mode of occurrence and probable quantity and value of the minerals which are contained in such property, and also the best method of obtaining the same from such a property. The government geologist, having a wider field, should have more comprehensive views, and his study should consider, not particularly the interests of any single mine, but rather the general interests of a whole group of mines or of a mining region, for it is a truism to say that trustworthy results are only obtained when they are founded on sound and accurate knowledge of the geologic structure of the region in which the deposits occur. As a mining engineer, I am sure that I am giving the opinions of my confreres when I say that if we do not give geology in our reports it is either because no data on the geology of the region have been published, or because our clients especially desire fact and figures, and not theories. From one of the heads of the United States Geological Survey, who I am glad to say was my old chief and instructor, I quote that there are three standpoints from which the relation of a geological survey to the mining industry of the country may be viewed: (1) the purely scientific or geological point, (2) the technical point, (3) the commercial point, and as from the nature of things the third point often demands only the consideration of a very small portion of a particular district, it is not the business of the government to consider such a view point.

The governing principle of a government Geological Survey in economic work should be that it will do for the mining industry, as a whole, what the unaided individual engineer or mine owner can *not* do, that it should never undertake what can just as well be done by the individual engineer or owner, and also that it should never interfere, favorably or unfavorably, with the private business of individuals or corporations, nor should it in any way enter into competition with professional men, such as mining engineers, commercial geologists, and chemists. It goes without saying, that no member of the Survey should be permitted to make any examinations, execute any surveys, nor write any reports for private persons or corporations. The energies of the department should be devoted to such branches as are of immediate use to the greatest number of the country's citizens, and along such lines investigation should lead either to the establishment of broad general deductions, or to the publication of monographs which have the most immediate bearing upon the prosperity of the country, and which are of value to as great, if not a greater number as the broad general investigations just mentioned. In a country containing so large an area as our Dominion, work by any force that can reasonably be employed must be confined for many years to such localities or districts as have contained the most extensive mining developments, or to such new sections as imperatively cry for authoritative investigation; and, apropos of studies in mining districts in which developments have been extensive, the geologist in making such studies often attains results which are of immediate value to the mine owners and prospectors in that particular section. Such results may be of secondary importance to the general public, but they are of immediate importance to the people interested, and are therefore justified, and the deductions from any such particular districts would, correctly generalized, be of benefit to the whole community.

It will be seen that many of the departments of the Survey are already equipped for the determination of such facts as I have mentioned, and if a new Bureau of Mines, or Economic Geology department, be established, any two such Bureaus would of necessity overlap each other, causing a waste of funds and of time if they were not correlated and under one jurisdiction. To separate such work into two departments would be a mistake, as neither branch in such a supposed case could, or would, avail itself of the information gained by the other. But in any proposed re-organization of the Geological Survey, or any organization of the proposed new Department of Mines, one fact should stand out clearly and distinctly, and that is, that the director and all subordinates of such department must, beyond any question or suspicion, be absolutely free from political interference or influence which can be exercised either to retain them in their office or to procure for them advancement. In my personal opinion, employees of such departments should not be on the permanent list; they should be made to feel that their status is dependent upon the work they do, and they should be treated as ordinary men are treated, and made to feel that so long as they perform their work satisfactorily they will be retained, but that no political influence, nor Civil Service Act, nor anything else will avail them against dismissal when dismissal is merited.

It is easy to forsee that, under such a Survey as I am attempting to indicate, demands would be made by citizens from all over the country, and to such an extent as to entirely overshadow the possible resources for any one year. The choice of field, therefore, in which work should be done may properly be governed by the principle, that developed districts give increased opportunities for obtaining a large number of facts, afford grounds for generalizations and for special studies, which not only are of permanent value to that particular district, but will be of great accessory value to other districts, with like or even dissimilar considerations. From partially developed districts only superficial facts can be obtained, and any expression of opinion as to the probable value of such a district is more properly the province of the mining engineer than of the geologist.

The general principle governing the work of any survey on economic lines should be that ore deposits must be studied where they can be studied to the best advantage, and hence that although topographic work to some extent may be well distributed geographically, yet all geologic work must be free from local or provincial considerations, and must depend upon the importance of the problems to be solved, and of the best methods of solving them. It is within the knowledge of all of us that that British Columbia district of so much reputation, I refer to Rossland, was under study by the Canadian Geological Survey as early as 1896, that a map and some descriptive geological text was published, but consider the effect upon the commercial world if the Survey had undertaken an economic investigation and had published a monograph on the Rossland district of as complete a kind as this publication which I hold in my hand (exhibiting a United States Monograph). Again, consider the copper-nickel industry of Ontario, and the Sudbury District in particular, and with the exception of the preliminary sketch of elemental conditions published in 1891 by the present acting director of the Survey, what else can be found in the records of the Canadian Survey which bears at all upon an industry which may be roughly figured as productive of at least four millions of dollars a year for the last nine or ten years? I mention these two cases because in my capacity as President of this Institute for the first two years of its existence, and also in my personal and private capacity as a practicing engineer, I have been repeatedly approached by agents of both English and American capital for information contained in Government reports bearing upon these two districts, and, although in our Library downstairs we have a complete set of the Survey reports, and although these reports were consulted by such agents, yet, I was forced to admit in many cases that it was not creditable to the Government of Canada, and particularly the Department of the Geological Survey, that they had no information to give to investigators

which was of *commercial* value or of assistance to capital which was willing to invest if proper data could be furnished to it.

Coming now to the special question of what a geological survey may, or should, do towards technical investigation, or making technical studies in aid of the mining industry, it is difficult to attempt definite limitations. There is the danger of encroaching upon what is the legitimate field of the professional man, the mining engineer or the metallurgist, but the same principal can govern this that should govern every other department, viz: that in such technical matters the Survey had better confine itself to those investigations which the State is better fitted to make than is the individual.

The prominence given during the last two or three years to the iron industry of the Dominion demands a satisfactory and technical monograph which should describe and give all information possible respecting the various iron ores of the Dominion, the facilities for transportation of such ores, and the opportunities or difficulties of reaching markets. The concentration of that important metal, nickel, in one small area in the Province of Ontario fully justifies an extensive monograph on the occurrence and origin of the ores, the associated metals, the methods of mining, sorting, smelting, refining and marketing the product, together with information of the amount of precious metals contained, and, in general, going into all such details as would not be of prejudice to the owners in that section but which would be of immense advantage and aid in studying similar occurrences of similar rocks in other fields.

The depressing conditions which have attached to the silver-lead mining industry during the last twelve months might well be made the subject of an exhaustive inquiry in which actual facts might be obtained, actual costs laid down, and the proper avenue for disposition of the product indicated.

It may be objected by some of our neighbors to the south that we are going too far in asking for such authoriative information, but we in Canada have a greater right to ask for such inasmuch as not only does each of the provinces impose a royalty upon the various metals produced, but even the Dominion Government, in the lands still within its control, imposes a heavy royalty which entitles us to ask for a *quid pro quo*.

Manifestly it is impossible. within the limits of such a paper as this, to notice the numerous pros and cons of argument which inevitably accompany the consideration of such a topic, but the duty which has been assigned to me has been simply to hand you out these various items as one might throw out so many balls which may be caught up by some of you and thrown about so as to provoke such a discussion as is absolutely necessary in order to obtain complete information.

I have spoken briefly of the primary work of the Survey, and its necessary subdivision into topography and geology with the correlated branches of petrography, paleontology and chemistry; there remains to be considered one of the chief, and I may say *most important*, functions of a properly constituted bureau of mines, or mining division, of the Geologocial Survey, and that is the collection of accurate statistics relating to the production of metals and minerals throughout the country.

This is the most important rock in the foundation of the mining business and is a first class reason for a mining bureau, if no other were forth-coming. It has been said, and well said, that no branch of statistical science is in greater need of technical knowledge and scientific system than that one which deals with the production of minerals, and I may add that none is more liable to bias and to be erroneous if the data are supplied by persons who are interested. The late Clarence King, in his introduction to the Tenth Census of the United States, (in which for the first time the collection of statistics of production from metallic mines were entrusted to a separate and expert corps of enumerators largely gathered from, and under the direction of the United States Geological Survey) said that the experience of the United States at that time was that the best method for conducting such investigation seemed to be the one then employed, viz: of utilizing trained experts in the collection of these figures, and that such a system would produce the most perfect results, under favorable conditions of sufficient time and sufficient money. He added that such agents required a considerable experience to become thoroughly familiar with their duties, and that this work would be best accomplished by making such a bureau a permanent one, thereby retaining the services of men familiarized and accustomed to their work. Such a method is perhaps too expensive and too ambitious for our young country, but there is nothing to prevent approaching it, and emulating the example which was then set by Mr. King.

One of the necessary adjuncts for such a bureau of statistics must be sufficient funds to permit of the prompt publication of its reports; a branch of the Survey with a single chief and a competent corps should be included in any project for a mining bureau or for a reorganization of the present Survey. Its field is large and its functions should include the issuance of bulletins regarding the location and descriptions of known mineral localities, including even those of the rarer substances. In each yearly publication, in addition to a general statement of the production of the country and of the distribution of the useful minerals, there could be monographs or short articles on the growth of each industry and on each important metal or mineral by an expert in that particular method or mineral who was an authority on his subject, and who would present a strong, terse, and lucid exposition of the conditions attaching to that particular industrial mineral. Such chapters being necessarily as different in scope and methods of treatment as the minerals and methods themselves, could also contain such technical information as would be of interest to the mining public particularly, and the common public generally. For examples of what has been done in this line, and as object lessons, I may bring to your notice the annual reports of the State Mineralogist of California, and also the bulletins which have been issued by that office. With such publications coming from a responsible head the government would practically issue an annual census of the mineral industry, and a production of over $70,000,000 a year fully justifies, in the eyes of the electors of this country, the study of the original sources of such mineral profits by a permanent bureau of sufficient size and properly endowed.

The minor questions of the water supplies of the country, the investigation of water powers and of possible irrigation supplies, is an undertaking worthy of any intelligent and self-respecting nation, and the utility of such a measure has already been recognised by an interested party—I refer to our great railway corporation—which has spent time and money in investigating the possible redemption of the arid lands of the North West Territories

While on the subject of monographs let me say that the more purely geological branch can also follow such a method of promptly communicating results of their studies to the public. Discussions of smelting processes, of milling methods, of concentration and of the equally important matters of transportation and marketing can easily be fitted into their proper places, and are legitimate objects for the direct recognition of the Government. The fact that jurisdiction over the different mines is lodged with provincial governments should be no drawback to a proper elucidation, description and recognition of the same by the federal government.

I have presented to you only a skeleton of the subject, but I trust that those who follow me will supply the sinews. flesh and covering so that by the end of the session we shall have a comely figure as the result of our combined efforts.

MINING INSTITUTE

Canadian Mining Men Urge the Establishment of a Dominion Department of Mines and Again Successfully Oppose the Efforts of the Canadian Society of Civil Engineers to Secure Close Incorporation.— Many Valuable Papers Presented.

The annual gathering of Canadian Mining Engineers and Mine Managers which for over eleven years have been held annually in Montreal were this year a huge success both from the point of attendance and the exceedingly interesting character of the proceedings. The meetings opened on Tuesday morning and were continued until Friday, sessions being held in the Club Room of the Windsor Hotel.

The following, among others, were present:—C. Shields, General Manager Dominion Coal Co., Sydney, C.B.; P. L. Naismith, General Manager Alberta Railway and Coal Co., Lethbridge, Alta.; W. H. Aldridge, Canadian Smelting Works, Trail, B.C.; Hon. J. H. Ross, Commissioner of the Yukon Territory, Dawson, Y.T.; T. W. Gibson, Director of the Bureau of Mines, Toronto; J. Obalski, M.E., Inspector of Mines, Quebec; Dr. Eugene Haanel, Superintendent of Mines, Ottawa; Dr. Robert Bell, Acting Director, Geological Survey, Ottawa: J. C. Drewry, Canadian Gold Fields Syndicate, Rossland; James McEvoy, Crow's Nest Pass Coal Co., Fernie, B.C.; Dr. J. B. Porter, M.E., Prof. of Mining Engineering, Montreal; Dr. W. Goodwin, Director School of Mining, Kingston; P. Kirkgaard, M.E., Canadian Gold Fields, Deloro, Ont.; E. D. Ingall, M.E., Chief Div. of Mineral Statistics, Ottawa; Prof. W. G. Miller, School of Mining, Kingston; Prof. T. L. Walker, Prof. of Mineralogy, Toronto University, Toronto; Alex. B. Allan, (Allan, Whyte & Co.) Glasgow, Scotland; J. A. Hanway, Colonial Copper Co., New York; J. T. McCall, Canada Iron Furnace Co., Montreal; Dr. Frank D. Adams, McGill University, Montreal; H. M. Wylde, Sec. Mining Society of Nova Scotia, Halifax; Wm. Blakemore, Mining Engineer, Montreal; John E. Hardman, S.B., Mining Engineer, Montreal; Milton L. Hersey, M.A.Sc., Montreal; George R. Smith, M.L.A., Bell's Asbestos Co., Thetford Mines, Que.; R. T. Hopper, Standard Asbestos Co., Montreal; E. W. Gilman, Canadian Rand Drill Co., Sherbrooke, Que.; Eugene Coste, Mining Engineer, Toronto; Dr. A. E. Barlow, Geological Survey, Ottawa; Dr. R. A. Daly, Geological Survey, Ottawa; Dr. R. W. Ells, Geological Survey, Ottawa; Dr. H. M. Ami, Geological Survey, Ottawa; R. W. Brock, Geological Survey, Ottawa; Jules Coté, Secretary Department of Mines, Quebec; E. R. Faribault, Geological Survey, Ottawa; A. A. Bowman, Canadian Rand Drill Co., Toronto; D. D. Mann, MacKenzie & Mann, Toronto; S. J. Simpson, James Cooper Manufacturing Co., Montreal; J. E. Boss, Spokane, Wash.; Chas. D. Maze, Civil Engineer, Montreal; Prof. G. R. Mickle, School of Practical Science, Toronto; D. W. Robb, Robb Engineering Co., Amherst, N.S.; E. P. Mathewson, Metallurgist, Montreal; Andrew MacKenzie, Dominion Coal Co., Montreal; Daniel Smith, Ontario Powder Works, Kingston; W. T. Rodden, Hamilton Powder Co., Montreal; Robert Chalmers, Geological Survey, Ottawa; Hugh Fletcher, Geological Survey, Ottawa; J. A. Dresser, M.A., Richmond, Que.; J. M. Clark, K.C,, Toronto; Frederick Hobart, Mining Engineer, New York; J. E. Rothwell, Mining Engineer, Tweed, Ont.; Chas. F. C. Hansen, Jas. Cooper Mnfg. Co., Montreal; W. W. Leach, Geological Survey, Ottawa; H. W. De-Courtenay, (Firth & Sons) Montreal; Captain Robert C. Adams, Montreal; Joseph James, Actinolite, Ont.; W. H. Smith, M.E., Canada Iron Furnace Co., Montreal; O. N. Scott, Listowel, Ont.; C. M. Doolittle, Hamilton, Ont.; J. B. Tyrrell, Mining Engineer, Dawson, Y.T.; C. O. Senecal, Geological Survey, Ottawa; C. P. Hill, Kitchener, B.C.; C. F. Ludwig, Mine Superintendent Dominion Coal Co., Sydney, C.B.; B. T. A. Bell, Editor CANADIAN MINING REVIEW, Ottawa.

There was also a large attendance of Mining Students from McGill University and the Mining School of Kingston.

TUESDAY MORNING SESSION.

The opening session was held on Tuesday morning, 4th March, in the Library of the Institute, Mr. J. E. Hardman, in the absence of the President through illness, presiding.

The Minutes of the last Annual Meeting having been published in Vol. IV of the Journal of the Institute were held as read. The following new members were elected at this and the later sessions of the Institute:—

A. A. Bowman, Canadian Rand Drill Co., Toronto, Ont.
Professor T. L. Walker, University of Toronto, Toronto, Ont.
John E. Rothwell, Mining Engineer, Tweed, Ont.
W. H. Smith, Canada Iron Furnace Co., Montreal, Que.
Frederick Hobart, Mining Engineer, New York, N.Y.
B. J. Forrest, Mining Engineer, Thornhill, Ont.
Alfred C. Garde, Mining Engineer, Payne Cons. Mining Co., Sandon, B.C.
Phelps Johnson, General Manager, Dominion Bridge Co., Montreal, Que.
C. P. Hill, Kitchener, B.C.
Hon. J. H. Ross, Commissioner Yukon Territory, Dawson City, Y.T.
C. F. Ludwig, Mines Superintendent, Dominion Coal Co., Glace Bay, C.B.
Dr. R. A. Daly, Geological Survey, Ottawa, Ont.
B. A. C. Craig, General Manager, Canada Corundum Co., Toronto.
Spencer L. Dale Harris, Ottawa.
Erne Dill Harris, Kingston, Ont.
H. W. McInnes, Mining Engineer, Halifax, N.S.
Lt. E. Dale Harris, C.E, Wei Hai Wei, China.
J. C. Drewry, Canadian Gold Fields Syndicate, Rossland, B.C.
Hamilton Lindsay, C.E., Toronto, Ont.
Allan Dale Harris, Montreal, Que.

SECRETARY'S REPORT.

Mr. B. T. A. BELL.—While the past year's operations in mining and metallurgical enterprise have been greater than at any period in the history of the Dominion, and there has been a very remarkable expansion in the production of coal and coke, iron and steel, nickel, copper and asbestos, the mining industry in certain districts of the West suffered from a depressed market for silver and lead, strikes, and, perhaps, more than to any other, from the natural and inevitable reaction following upon a period of unwholesome speculation in mines and mining shares. Later on in this report, I hope, as I did last year, to submit a few notes and statistics reviewing the more prominent features of mining activity in the various provinces and I only refer to this depression now as it has to some extent reflected upon the affairs of the Institute and may account for the fact that our membership does not show as large an increase as it did this time last year.

MEMBERSHIP.

At 31st December last our membership had increased to 331 as compared with 323 in 1900, 277 in 1899, and 192 when the Institute was reorganized under its present Charter in 1898.

It is also pleasing to note that while as usual at our Annual Meeting we lose a number of members our strength will be maintained, if not increased, by the acquisition of those who have been elected since the printed list was distributed, and by others, whose names will be submitted for your approval at this meeting.

Our Student Membership will, it is gratifying to report, be considerably reinforced by the affiliation en bloc of the members of the Mining Society of McGill, under a special clause in the By-Laws, recommended for your adoption by the Council.

The thoroughly representative character of our membership, embracing as it does the best elements in the profession and industry of mining in Canada, and its distribution by provinces and countries, will be seen by a reference to the printed list sent to members in January.

MEMBERS REMOVED BY DEATH.

It is my painful duty again to record the loss of three members by death since our last meeting together.

Mr. Lionel Shirley, Civil and Mining Engineer of Montreal, a gentleman who took a deep interest in the affairs of the Institute, died early in the year in the Western States whither he had gone on account of poor health. Latterly Mr. Shirley had been engaged in railway engineering but he will be remembered as one of the pioneers in the palmy days of phosphate mining on the Lievre and as the engineer who opened up that remarkable deposit of muscovite mica known as the Villeneuve Mine.

Mr. James F. Lewis, President of the Canadian Rand Drill Company of Sherbrooke, Que., who died after a long and painful illness, at Boston on July 23rd. A member of the Council, he was a never failing attendant at all its meetings, often at great inconvenience to himself and his business, while he was ever ready to give his time and his energy to promote the best interests of our organization. In the death

of genial, big-hearted "Jim" Lewis the Institute has indeed sustained a severe and irreparable loss.

Mr. J. Roderick Robertson, General Manager of the London & B. C. Gold Fields, Limited, of Nelson, B.C., killed by an explosion of dynamite, in the Murray Hill Hotel, New York on 27th January. Mr. Robertson was one of the most widely known and respected mining men in British Columbia. A shrewd, far-seeing, highly capable man of business, genial, kindly and generous in disposition, "Rod." Robertson was greatly liked by every one and the conspicuous success of the large mining corporation of which he was the active head, was very largely due to his enterprise and ability.

MEMBERS SERVING IN SOUTH AFRICA.

In my last report attention was called to the fact that four members of the Institute were with different regiments in South Africa. Captain J. Edwards Leckie, D.S.O., M.E., of Greenwood, B.C., who served with distinction as an officer in Strathcona's Horse, accompanied by his brother Captain R. G. Leckie, M.E., of Vancouver, B.C., and Captain Bruce Carruthers of Kingston, all members of the Institute, have again volunteered their services on behalf of the Empire and are now serving in South Africa with the 2nd Canadian Mounted Rifles. Major Hamilton Merritt who has gone out as second in command of this fine regiment is also a well known Canadian Mining Engineer and at one time was a member of the Council of the Institute.

MEETINGS AND PUBLICATIONS.

The Annual Meetings of the Institute were held at Montreal on 6th, 7th and 8th March and were, as usual, exceedingly well attended. Twenty-three papers were presented and these, together with the transactions of the Institute during the year, constitute the fourth volume of our Journal published and distributed to members in June. This volume was widely distributed among the principal British, American, European, and Colonial mining societies and it was favorably noticed by the leading mining journals, a number of them reprinting some of the papers.

The other publications were: 500 copies of the Secretary's Annual Report; 300 copies of Dr. Adam's paper on the "Iron Ores of Bilboa;" 50 copies of Professor Miller's paper on the "Iron Ore Fields of Ontario;" and 500 copies of the List of Members.

STUDENT'S COMPETITION.

Three very creditable papers were presented to our transactions in competition for the President's prize, the Council ultimately awarding the medal to Mr. C. V. Corless, of McGill, for his description of the "Coal Creek Colliery" of the Crow's Nest Pass Coal Co.

SUMMER EXCURSION.

Very complete arrangements were made for an excursion during the first week of September to the nickel, copper and iron mines of Sudbury and Sault Ste. Marie returning by way of the Hastings County gold mines, but as it was found impossible at the time to get such an attendance of members as this important field warranted the event was postponed.

LEGISLATION.

In accordance with a resolution adopted at the Annual Meeting a deputation from the Institute had an interview at Ottawa with the Premier, the Right Hon. Sir Wilfrid Laurier, and other Ministers, and asked for the disallowance of the "Act to Amend the Mines Act" adopted by the Ontario Government in 1900, imposing prohibitory taxation on copper and nickel ores. It is satisfactory to know that while the Dominion Government did not disallow the Act its constitutionality will be made the subject of a special test case between the two Governments at no very distant date.

LIBRARY AND READING ROOM.

Our collection of books, periodicals, maps, photographs, etc., has been considerably extended during the year, the following, among other works on mining and metallurgical practice being added: Schnabel's "Metallurgy", two vols.; Locke's "Gold Milling;" James on "The Cyanide Process," and Vol. IX of the "Mineral Industry." A large number of exchanges and periodicals were also bound and the photographs suitably framed. This collection, now a very valuable one, has attained such dimensions that the present quarters in the Windsor Hotel are becoming too small for its proper accommodation and it will be necessary very soon to seek additional premises either in the hotel or elsewhere.

The Report was adopted.

RESOLUTIONS OF SYMPATHY.

Mr. Wm. Blakemore having referred in feeling terms to the loss sustained by the death of Mr. J. Roderick Robertson moved the following resolution:—

"That the Canadian Mining Institute in Annual Meeting assembled desires to place on record its sense of the serious loss sustained by this Institute and by the mining community of British Columbia in particular through the lamented death of the late Mr. Roderick Robertson and wishes to extend to his family its sincere sympathy in their bereavement."

The Chairman referring to their late co-worker Mr. James F. Lewis, intimated that he hoped to contribute to their Transactions an obituary note referring to his services to the mining industry and to the Institute.

TREASURER'S REPORT.

Mr. J. Stevenson Brown presented his statement of accounts duly audited covering the year ended 31st. January showing: Receipts $4590.61; Disbursements $3,633.21; Cash balance on hand $957.40.

The report was adopted.

AMENDMENTS TO BY-LAWS.

The Secretary submitted copy of the By-Laws containing certain amendments recommended by the Council.

These were on motion adopted.

CANADIAN SOCIETY OF CIVIL ENGINEERS' BILL.

The Chairman—The Canadian Society of Civil Engineers is again seeking legislation in the Ontario and Manitoba Legislatures with the object of making it a close corporation in these Provinces. The bill was considered at a meeting of the Council last evening and it was decided to refer further action upon it to this meeting.

Mr. Coste—The Bill is not so bad as it used to be. The exemption of the members of our Institute and those engaged in mining seems to cover the ground very well.

Mr. Bell—Let the other engineers—those who are not members of the Society—fight it if they want to.

The Chairman—When we look at this thing as members of the Instiiute we have no kick coming.

Dr. Adams—As an Institute we can guard ourselves as individuals.

Mr. Blakemore—In the practice of my profession I may be called upon to survey or build a railroad. Would I not be required, under this Bill, to belong to the Canadian Society of Civil Engineers?

Dr. W. L. Goodwin—I think the Institute has one or two courses open to it with regard to this Bill. In Section 2 "No person shall be entitled within the Province of Ontario.....to act or practice as a civil engineer"; the term Civil Engineer is not defined here or elsewhere in the Bill. In Sec. 4 we find "All By-Laws of the Society shall be valid and shall be deemed to apply"—if enacted would this not give the Canadian Society of Civil Engineers what would amount to legislative powers? With regard to definitions, examination of the Quebec Act shows that the Society defines a C. E. to cover every kind of engineer whatsoever and there is nothing in this Bill to prevent them, if the Bill becomes law, from defining it in the same way in Ontario. In Section 2, Clause D "unless he is entitled to do so as the holder of a diploma or of a degree conferred by some institution of learning in the Dominion of Canada so to do." In this clause, the words "unless he is entitled to do so" are indefinite and Section 4 would give the Society power to make all By-Laws, define the kind of diploma or degree which would entitle the engineer to practice as a C. E. (also defined by the By-Laws of the Society). Section 2, Clause E together with Section 4 would give the power to apply any test whatever to engineers coming into Canada from Great Britain or the United States and while I do not wish to impute any unfairness or motive it would manifestly be unwise to give such powers to a Society which represents only a section of the engineering profession. Section 8 is as broad and fair as a qualification could possibly be made. It reads "This Act shall not be deemed to apply to members of the Canadian Mining Institute in so far as concerns their operations as mining or metallurgical engineers or in any way whatever in the management or operation of mines or metallurgical works." This power can be worked so as to inflict hardship on mining engineers and metallurgical engineers and on their employers. Had this Act been in operation during the past two years it might have been used to prevent, or to interfere with the designing and construction of the extensive projects and shipping facilities of the Helen iron mine under the provision of "Any other than a member of the Canadian Society of Civil Engineers." The whole objection to the Bill can be summed up as follows:—It must be first shown that legislation is necessary and that the engineering profession is suffering from the lack of it, and when this is established it must then be shown that it would be wise to confer such powers to a body duly representing a section of the engineering profession of Canada. I contend that such action would neither be wise nor just. If restrictive powers are to be given at all they should be given to some Society or Association which represents the whole engineering profession. Therefore, Gentlemen, I think the duty of the Institute is plain, not to touch the Bill at all in any way but let it meet its fate in the Ontario Legislature. (Applause.)

Mr. J. Stevenson Brown—The whole mining interests of Ontario might be prejudiced by the passing of this Act and it is our duty to oppose it.

Mr. B. T. A. Bell—The Bill hasn't got a thousand to one chance of passing anyway.

The Chairman—After hearing Dr. Goodwin's very lucid statement of object-

ion to the present Bill it seems to me to be the duty of the Institute to enter the fight again.

Dr. ADAMS—While fully approving of what Dr. Goodwin has said it seems to me we are expressly exempted as mining engineers from the operations of this Act. The supposition of Mr. Blakemore that he would be denied the right to design or construct a railway or dam seems to be very fully provided for by the exemption in favor of members of our Inst tute.

DR GOODWIN—The clause under C. E. in this Act is to be interpreted by the By-Laws of the Canadian Society of Civil Engineers. My objection is that the Act relegates t › this Society, a body only representing a section of the engineering profession, powers which can by these By-Laws be made to apply to the whole profession.

After some further discussion the Secretary, on motion, was instructed to wire the Chairman of the Private Bills Committe in Ontario and Manitoba Legislatures protesting against the passage of any such legislation in favor of the Canadian Society of Civil Engineers.

SCRUTINEERS APPOINTED.

On motion, Messrs. H. W. DeCourtney and W. Blakemore were appointed Scrutineers for the election of officers.

APPOINTMENT OF AUDITORS.

On motion, Messrs. George Macdougall and H. W. DeCourtney were re-elected auditors for the ensuing years.

SUMMER EXCURSION.

The SECRETARY suggested that the excursion postponed last year, visiting the Sudbury, Sault St. Marie and Hastings County mining districts be, if possible, carried out th's y›ar. He also suggested that as these districts would be of particular interest to them, the members of the Lake Superior Mining Institute might be invited to participate in these excursions as the guests of the Institute.

Mr. COSTE—It would be to our advantage to have them with us.

The suggestion meeting with hearty approval of the members it was agreed to leave the details in the hands of the Secretary.

The meeting adjourned at one o'clock.

TUESDAY AFTERNOON.

The members assembled in the Club Room at three o'clock, Mr. J. E. Hardman in the Chair.

The CHAIRMAN, having called the meeting to order, expressed the regret of himself and the members at the unavoidable absence through illness of their President Mr. Chas. Fergie.

The following papers were read by title:—

1. Notes on Gold Dredging.
   By F. Satchell Clarke, Vancouver, B.C.
2. On a Method of Mining Low Grade Ore in the Boundary District, B.C.
   By Frederic Keffer, M. E., Anaconda, B. C.
3. On The Copper Bearing Rocks of the Eastern Townships.
   By John A. Dresser, M. A., Richmond, Que.
4. On the Analysis of Insolubles.
   By Douglas Lay, A.R.S.M. Nelson, B.C.
5. Notes on Wire Ropes.
   By W. D. L. Hardie, M. E., Lethbridge, N.W.T.
6. Notes to Accompany Plan and Drawings of the Athabasca Mine, Toad Mountain, B.C.
   By E. Nelson Fell, A.R.S.M., London, England.

ORES OF THE BOUNDARY DISTRICT.

Mr. R. W. BROCK of the Geological Survey gave an interesting address on the geological features and character of the ores of the Boundary Creek District of British Columbia.

A paper by Dr. Ledoux of New York on Copper Production in the same district was taken as read, Dr. Ledoux being unable to reach Montreal in time for the meeting in consequence of the floods.

DAWSON AND SELWYN PORTRAITS.

The CHAIRMAN—Before going on with the papers I would like to call your attention to the fact that we have with us the Acting Director of the Geological Survey, Dr. Robert Bell, and in the absence of the President, it becomes my duty to present to him for the Survey the portraits of two of its former Directors. These portraits were purchased by funds entirely separate from the Institute. We all recognize the great services rendered by them to make known the mineral wealth of this country. I have much pleasure in presenting them to the Survey on behalf of the Institute.

Dr. ROBERT BELL—I have to thank you all for your liberality in subscribing to the funds for these two splendid portraits of my predecessors—Dr. Selwyn and Dr. Dawson. The former was Director for twenty-five years and before that held positions in Australia and Great Britain. Dr. Dawson was on the Survey since 1875 and was Director for the last six years. The portraits will be very welcome to us. We have the portrait of Sir William Logan and now with these will make the three Directors. I have only again to thank you for the kindly thought which prompted the presentation of these portraits.

PRESENTATION OF THE STUDENT'S MEDAL.

The CHAIRMAN—Then called for Mr. C. V. Corless, an undergraduate of McGill, and on behalf of Mr. Fergie presented him with the President's gold medal awarded by the Council for the best paper contributed during the year to the Transactions of the Institute.

Mr. Corless briefly and suitably replied.

MINING PROGRESS IN CANADA DURING 1901.

Mr. B. T. A. BELL—Last year in my Annual Report to the members I incorporated a review of the principal features of our mining progress during the previous year. That statement was found to be of some service to the members and is my excuse for again presenting to you such authentic figures as I have been able to gather together respecting the mineral development of the Dominion during 1901. From figures furnished direct to me by the courtesy of the mine managers, and the returns given by the various Provincial Bureaus of Mines, a conservative estimate would place the total value of the mineral production of the Dominion in 1900 at a little over seventy millions of dollars, distributed as follows:—

YUKON.	
Gold, Silver, Coal	$18,500,000
BRITISH COLUMBIA.	
Gold, Silver, Copper, Lead, Coal, Coke, etc	20,713,501
ALBERTA, ASSINIBOIA, MANITOBA.	
Coal, Gold, Gypsum, Platinum, Building Material	1,700,000
ONTARIO.	
Copper, Nickel, Iron, Steel, Gold, Silver, Zinc, Arsenic, Corundum, Natural Gas, Petroleum, Salt, and other products	11,712,188
QUEBEC.	
Asbestos, Iron and Steel, Chromite, Graphite, Mica, Ochres, Barytes, etc	3,500,000
NEW BRUNSWICK.	
Copper, Manganese, Coal, Gypsum, Building Material etc	1,000,000
NOVA SCOTIA.	
Coal, Coke, Iron, Steel, Gold, Gypsum, Grindstones, Building Material	13,000,000
Estimated Total Mineral Production of the Dominion of Canada in 1901	$70,125,689

COAL.

In its relative value to the trade and commerce of the country the greatest of our mineral industries is unquestionably the production of coal which shows a considerable increase in tonnage and values over any previous year in the history of coal mining in Canada, From figures furnished direct to me from the collieries a close estimate would place the total quantity of coal mined in Canada in 1901 at 5,748,845 tons of an estimated value at the pithead of not less than $18,000,000. The distribution of this output was as follows:—

From Nova Scotia	3,834,360 tons.	
" British Columbia	1,529,210 "	
" Alberta, Assiniboia and Manitoba	370,275 "	
" New Brunswick	10,000 "	
Yukon	5,000 "	
Total Coal Raised in 1901	5,748,845 tons.	5,748,845 tons.
Bituminous Coal imported during the year	3,135,158 "	
Total Bituminous Coal	8,884,003	8,884,003 tons.
And Exported		
To Great Britain	29,909 "	
" United States	1,395,142 "	
" Newfoundland	83,153 "	
" Other Countries	65,457 "	1,573,661 tons.
		7,310,342 "
We also imported Anthracite Coal		2,024,383 "
Making the total consumption of coal in the Dominion during the past calendar year		9,334,725 tons.

COKE.

The product of our coke ovens will also show a considerable increase. Returns show the output from Nova Scotia to have been 241,936 tons and from British Columbia 134,760 tons, or a total coke output of 376,696 tons. During the year we exported 57,505 tons and imported 652,710 tons.

IRON AND STEEL.

As Mr. Drummond will, doubtless, deal very fully with these industries in his paper, I will only briefly summarize the returns forwarded to me, showing as they do a very marked and extremely gratifying expansion over previous years.

ORE PRODUCTION.

Province of Nova Scotia:—		
Mined by Nova Scotia Steel Co		18,619 tons.
Province of Quebec:—		
Mined by Canada Iron Furnace Co	11,808 tons.	
Shipped by Ottawa & Gatineau Valley Railway	750 "	
Other estimated	1,000 "	13,558 "
Province of Ontario:—		
Mined by Lake Superior Power Co	261,203	
Shipped from Madoc via G.T.R	305 "	
" " Trenton via G.T.R	2,134 "	
Add difference to balance figures reported by Bureau of Mines	8,896 "	272,538 "
Total Iron Ore mined in Canada in 1901		304,715 "

IRON ORE IMPORTED.

By Dominion Iron and Steel Co :—		
From Spain	23,411 tons.	
" United States	16,428 "	
" Cuba	11,191 "	
" Newfoundland	385,329 "	436,359 tons.
By Nova Scotia Steel and Coal Co :—		
From Newfoundland	32,801 tons.	
" Cuba	117 "	32,918 "
By Canada Iron Furnace Co :—		
From United States	9,275 tons.	9,275 "
By Hamilton Steel and Iron Co :—		
From United States	56,849 tons.	56,849 "
By Deseronto Iron Co :—		
From United States	17,602 tons.	17,602 "
Or total Ore Imports of		553,003 tons.

RECAPITULATION.

From Newfoundland	418,130 tons.
" United States	100,154 "
" Cuba	11,308 "
" Spain	23,411 "
	553,003 tons.

IRON ORE EXPORTED.

During the calendar year we exported as per Trade and Navigation Returns 306,244 tons of iron ore of an estimated value of $774,673.

PIG IRON MADE.

Province of Nova Scotia :—		
Dominion Iron and Steel Co	111,014 tons.	
Nova Scotia Steel and Coal Co	26,793 "	137,707 tons.
Province of Quebec :—		
Canada Iron Furnace Co	5,400 tons.	
Macdougall & Co	656 "	
Electrical Reduction Co	300 "	6,356 "
Province of Ontario :—		
Canada Iron Furnace Co	33,648 tons.	
Deseronto Iron Co	9,975 "	
Hamilton Steel and Iron Co	67,512 "	111,135 "
Total Pig Iron made in Canada		255,198 tons.

PIG IRON EXPORTED.

Trade and Navigation Returns show that 57,600 tons of a value of $593,739 were exported during the calendar year.

STEEL MADE.

Province of Nova Scotia :—	
Nova Scotia Steel and Coal Co., Ingots	25,678 tons.
Province of Ontario :—	
Reported by Bureau of Mines	14,471 tons of a value of $347,280
Total Steel made	40,159 tons

IRON AND STEEL BOUNTIES PAID.

The following bounties were paid by the Dominion Government during the fiscal year ended 30th June last :—

ON PIG IRON.

Canada Iron Furnace Co :—	
Radnor Forges—	
Production to June 30th, 1901—	
5,463,945 tons from Canada ore at $3	$16,391 83
111,565 tons from foreign ore at $2	223 13
Midland, Ont :—	
Production 7 m. to June 30th, 1901—	
18,948,10 tons from Canada ore at $3	56,844 30
1,162,525 tons foreign ore at $2	2,325 05
Deseronto Iron Co :—	
Production 14 m. to June 30th, 1901—	
54 tons from Canada ore at $3	162 00
13,653 tons from foreign ore at $2	27,306 00
Dominion Iron and Steel Co :—	
Production 5 m. to June 30th, 1901—	
27,643,695 tons from foreign ore at $2	55,287 39
Electric Reduction Co., Buckingham :—	
Production January, 1900 to April, 1901—	
391 tons from Canada ore at $3	1,173 00
Hamilton Steel and Iron Co :—	
Production 13 m. to June 30th, 1901—	
15,033,16 tons from Canada ore at $3	45,099 48
38,678,07 tons from foreign ore at $2	77,356 14
John McDougall & Co :—	
Production January 1st to May 14th, 1901—	
79,315 tons from Canada ore at $3	2,379 46
Nova Scotia Steel and Iron Co :—	
Production 13 m. to June 30th, 1901—	
9,897,295 tons from Canada ore at $3	29,691 88
18,509,705 tons from foreign ore at $2	37,019 41
	$351,259 07

BOUNTY ON PUDDLED BARS.

Hamilton Steel and Iron Co :—	
Production 13 m. to June 30th, 1901—	
5,567,695 tons at $3	$16,703 09

BOUNTY ON STEEL INGOTS.

Hamilton Steel and Iron Co :—	
Production 13 m. to June 30th, 1901—	
9,436,985 tons at $3	28,310 96
Nova Scotia Steel Co :—	
Production 13 m. to June 30th, 1901—	
23,915,595 tons at $3	71,746 78
	$100,057 74

IRON AND STEEL EXPORTS.

(As per Trade and Navigation Returns.)

Stoves	$ 7,438
Castings	67,140
Machinery	470,136
Sewing Machines	18,279
Scrap	168,438
Hardware	95,213
Steel	416,796
Bicycles	381,569
Parts Bicycles	78,547
Total exports	$1,703,556

OUTPUT OF GOLD.

From Yukon	$18,000,000
" British Columbia	5,596,700
" North West Territories	40,000
" Nova Scotia	620,000
" Quebec	1,440
" Ontario	244,443
Total gold production	$24,502,583

OUTPUT OF COPPER.

From British Columbia	$4,951,698
" Ontario	627,080
" New Brunswick	100,000
Total copper production	$5,678,778

IMPORTS OF COPPER.

Scrap	$ 6,133
Ingots	121,562
Bars	593,344
Sheets	270,591
Tubing	42,729
Rollers	10,111
Rivets	6,828
Wire	99,540
Cloth	604
Other	49,405
	$1,200,847

OUTPUT OF LEAD.

British Columbia	50,529,260 lbs. of a value of	$1,970,641
Quebec shipped	554,000 " " "	11,350
	51,083,260 lbs.	$1,981,991

LEAD IMPORTS.

Pig	$137,561
Bar	69,178
Pipe	11,293
Shot	1,932
Other	53,105
Nitrate	12,533
Tea	50,145
	$335,747

NICKEL MATTE.

Ontario, as reported by Bureau of Mines	$627,080

SILVER.

From British Columbia, 4,685,718 ozs. of a value of	$2,624,002
" Yukon	125,000
" Ontario, 151,400 ozs. of a value of	84,830
" Quebec (in concentrates) estimated	5,000
Total silver production	$2,838,832

The quantity exported as shown by Trade and Navigation Returns was 3,513,500 ounces of a value of $2,016,727, and bullion exported during the first six months of the year of a value of $8,865 or a total of $2,025,592.

ASBESTOS PRODUCTION.

The production of this valuable mineral is entirely confined to the Province of Quebec and during 1901 was the largest in quantity and value since this industry was established in the early eighties. Returns of shipments show :—

Via Quebec Central Railway :—		
From Coleraine	64,000 lbs.	
" Black Lake	9,520,551 "	
" Thetford Mines	48,431,750 "	
	58,016,301 lbs. or	29,008 tons.
Via Grand Trunk Railway :—		
From Danville		5,468 "
Via Ottawa Northern and Western :—		
From Low	40,880 lbs. or	20 "
Total Asbestos shipped		34,496 tons.

ASBESTIC.

Via Quebec Central Railway :—		
From Black Lake	2,301,040 lbs. or	1,150 tons.
Via Grand Trunk Railway :—		
From Danville		4,758 "
Total Asbestic shipped		5,908 tons.

Of these shipments, Mr. Obalski, the Government Inspector of Mines has sent me the following distribution by grades :—

No. I	2,083 tons of a value of		$348,579
No. II	2,660	" "	263,855
Fibre	14,659	" "	450,193
Paper stock	14,054	" "	211,688
Asbestic	6,831	" "	10,114
Total	40,287	" "	$1,284,429

These shipments were to Great Britain, United States, Germany, France and other countries.

COPPER PYRITES.

The production of this mineral which for many years has been confined to the Eustis and Nichols mines in the Eastern Townships of the Province of Quebec was augmented in 1901 by two new sources of supply in the same district and by the output from a promising mine in the Township of Massey, Ontario. A portion of this was utilized for the manufacture of sulphuric acid and other chemicals in Canada. The value of the year's production would probably approximate about $160,000 of which Mr. Obalski estimates that $126,000 came from the Province of Quebec.

CHROMITE.

The Eastern Townships of Quebec, as in former years, furnish the output of this mineral, which may be placed at $50,000. Mr. Obalski estimates that the shipments of No. I grade amounted to 528 tons of a value of $9,424 and 610 tons of No. II valued at $7,320 with a balance on hand at the end of the year of 350 tons of No. I and 3,200 tons of No. II. It is worthy of note that several hundred tons have been used at Buckingham by the Electrical Reduction Company in the manufacture of ferro-chrome. One of the many remarkable things brought out by an examination of the Trade and Navigation Returns is that these quote the shipment of 759 tons at a valuation in excess of $30.00 per ton, a figure entirely out of proportion to the market prices for this mineral.

MICA.

The production of Mica was, as in previous years, confined to the Provinces of Ontario and Quebec and in 1901 would approximate $200,000. A feature of the year was the largely increased home consumption of mica for electrical insulation, its use in the manufacture for boiler coverings, and the steadily growing demand for it in Great Britain and on the Continent. The exports during the calendar year were:—

To	Cut.		Trimmed.	
	Lbs.	Value.	Lbs.	Value.
Great Britain	54,199	$17,024	47,750	26,394
United States	203,537	49,846	11,329	1,547
Other Countries	4,440	1,690	3,230	427
	262,176	68,560	62,309	28,368

To	Untrimmed and Ground.		Total.
	Lbs.	Value.	Value.
Great Britain	20,160	5,070	48,488
United States	269,856	49,834	101,227
Other Countries	4,285	721	2,838
	294,301	55,625	152,553

GRAPHITE.

This industry, although still not a very large one, gives evidence of growth and promises to assume larger dimensions in the near future. The bulk of the production in 1901 came from Ontario but the acquisition of the strong company recently organized in the United States to work the Walker Mine at Buckingham, Que., should give an impetus to the production of this valuable mineral during the present year. The exports during the calendar year are reported to have been 21,653 cwt. of a value of $35,102. During the same period we imported plumbago, crucibles and other manufactures of graphite of a value of $55,564.

PHOSPHATE.

The production of this, at one time, one of the prominent mineral industries of the Dominion, was, as last year, confined to the quantity raised as a by-product of mica mining in the Provinces of Quebec and Ontario and probably did not exceed a value of $10,000 of which Mr. Obalski estimates that $6,280 was furnished by Quebec. It is, however, significant that the Trade and Navigation Returns show an import of this mineral from the United States of a value of $8,219 presumably for the Electrical Reduction Co. at Buckingham, Que., once the great centre of phosphate production in Canada.

OTHER MINERALS.

Trade and Navigation Returns for the year show the other exports to have been:—Felspar 4,369 tons of a value of $10,973 ; Antimony (from Quebec) 10 tons of a value of $1,643; Manganese 440 tons of a value of $4,820; Slate 16,750 tons of a value of $10,000; Salt 39,224 bushels of a value of $6,510; Ochres 801,553 lbs. of a value of $7,233; Gypsum crude 235,995 of a value of $231,385; manufactured ditto of a value of $15,333; Oil crude and manufactured, $36,425; Granite, Limestone, Bricks and other building materials $158,066; Grindstone crude and dressed, $8,688.

BRITISH COLUMBIA.

This Province occupied the leading position among the mineral producing territories of the Dominion, the value of her mineral production in 1901 having increased from $16,344,751 in the previous year to $20,713,501. Mr. W. F. Robertson, the Provincial Mineralogist, in a bulletin issued last month, estimated the quantity and value of the various products as follows :—

	1900.		1901 (Estimated).	
	Quantity.	Value.	Quantity.	Value.
Gold, placer.....ozs	63,936	$1,278,724	43,204	$892,500
" lode ... . "	167,153	3,453,381	227,696	4,704,200
Silver. .... "	3,958,175	2,309,200	4,685,718	2,624,002
Copper..... .....lbs.	9,997,080	1,615 289	30,736,798	4,951,698
Lead..... "	63 358,621	2,691,887	50,529,260	1,970,641
Coal.....long tons	1,439,595	4,318,785	1,529,210	4,587,630
Coke..... "	85,149	425,745	134,760	673,800
Other materials	.....	251,740	.....	309,030
Totals.....	.....	$16,344,751	.....	$20,713,501

Writing to me under date of 1st February, Mr. Robertson briefly reviews the features of the year's progress, as follows :—

"This estimate, I am satisfied, will be found 'within the mark' when the final statistics are completed. It will be seen that the total gross value of the output, including coal, etc., has this past year increased some 25 per cent., while the product of the lode mines has increased from $10,069,757 to $14,250,541, or about 40 per cent. The tonnage of the lode mines for 1901 is estimated at 909,223 tons as against 554,796 in 1900, an increased output of about 64 per cent.

The value of the coal and coke industry is estimated as $5,261,430, as against $4,744,530 for 1900, an increase of over 10 per cent., and this is limited only by the limited market and defective transportation facilities, matters soon to be remedied.

These figures speak rather eloquently of the progress of the Province as a mineral producer. To review the Province by districts:—

As yet the *Northern districts* are entirely placer gold producers, and this year there is a decrease of some 35 per cent. in placer gold output. This is to be accounted for as follows :—

In *Atlin district* the camps are about changing from sluicing to hydrulic methods, and the couple of hydraulic plants expected to have made an out-put were tied up by legal squabbles between themselves and also with the owners of individual claims.

The *Chilkat section* has done nothing, partly owing to excessive rainfall, causing floods which three times washed away all works.

In the *Cariboo district* the hydraulic mines, notably the Consolidated Cariboo Hydraulic Company, found themselves short of water supply during the last part of the season, owing to the sudden warm weather in spring carrying off the snow very rapidly and so leaving no supply for the later months.

In *East Kootenay* lode mining is largely confined to low grade silver-lead ores, and the market price for such ores has been so exceedingly low as to leave little, if any, profit to the mines.

This is one of the most serious problems in the Province to be faced and cannot be here discussed. Relief from these conditions is hoped for by the establishment of a lead refinery now under construction. This section would have shown a considerable decrease but for the increased output of coal and coke.

IN WEST KOOTENAY.

Slocan has about held its own both in tonnage and values, the higher silver contents of the Slocan ores enabling shipments to be made despite the low market for lead-bearing ores.

Nelson is expected to make a very considerable increase owing to the increased out-put of gold ores and to the resumption of shipping of ore from the Silver King mine (Hall Mines Ltd).

Trail Creek has always been a "storm centre" and had its share of labor troubles, but, somehow or other, the yearly out-put has increased despite certain stoppages.

In *Yale district* productive mining is practically confined to the *Boundary* section, where the enormously increased output of very low grade copper-gold-silver ores has been brought about by the establishment of transportation and smelter facilities.

The *Coast district* has about held its own both in coal and lode mining, a number of copper properties have come forward and promise much for the future.

The increase in production during the past year has been a very agreeable surprise to most people, so persistent have been the attempts on the part of certain unsuccessful operators to circulate reports to the contrary effect.

The so-called "labour question" has caused much uneasiness, but I think such is unwarranted. There is no doubt but that the mine labour obtainable in the Province is, on the average, very poor, chiefly through inexperience. Under normal conditions this would soon remedy itself, but when the tonnage out-put increases at the rate of 64% per annum it is quite impossible to expect that miners can be trained at that rate.

The rates of wages for this class of labor are very high as compared with the other provinces of the Dominion, but the demand for such labour is so great that it is no wonder that the men demand, and get, high wages.

It is recognized that many of the low grade properties cannot go on paying such wages ; this means a delay until conditions are readjusted by time and an increased population. The only important strike that occurred during the year was in the Rossland camp, and this, I am glad to say, has been adjusted."

YUKON TERRITORY.

While there has been a shrinkage in the value of the gold production, the progress of mining in the Yukon has been entirely satisfactory, the total output during the past year being estimated at about eighteen and a half millons of dollars, as follows :

Gold dust and bullion received at Government Assay Office Seattle.....	$10,915,000
Purchased by United States Mint and Selby Smelting Company, San Francisco	6,680,000
Add dust not reported and dust used in Territory as a medium exchange say.....	1,000,000
Or an estimated production of.....	$18,500,000

The production during the preceding years was :—1897, $2,500,000 ; 1898, $10,000,000; 1899, $17,500,000, and in 1900, $28,000,000. A district which has produced over $73,000,000 in five years must take rank not only as Canada's greatest gold-field but as one occupying a leading position among the gold-fields of the world.

Mining in the Yukon territory has been assuming a condition of much greater stability than prevailed during the previous years, and among the men who are acquainted with or are interested in the Klondyke gold fields there is a greater feeling of confidence and assurance that the richness and extent of the gold-bearing area is only just beginning to be truly appreciated. It is quite true that some of the richest spots on Eldorado and Bonanza Creeks have been almost worked out, often quite regardless of the cost at which the work was being prosecuted, for, let the working costs be ever so high, these costs still, in the cases of some of the richest claims, amounted to but a small percentage of the gross output of the mines. Although these claims are now seriously depleted, and although there may be no other part of the Territory where three miles and a half of a creek valley will yield twenty-five or thirty million dollars' worth of gold, as Eldorado Creek has done, still there are extensive tracts, in the bottoms of valleys, and on terraces along their sides underlain by gravel rich in gold, from which the precions metal will be washed out in large quantities for many years to come. The existence of the very rich pockets, such as those on Eldorado Creek, encouraged extravagance of every kind, but with the depletion of these profits, and the realization of the idea that the wealth of the country lies chiefly in its lower grade gravels, better machinery and organization and more economical methods have been introduced, and the district is entering a state of solid and quiet prosperity, founded on moderate profits, and moderately remunerative work for a large number of people, rather than on excessive profits and very high wages for a few.

In 1898 the method of mining all the deeper gravels, which are frozen from the surface down to bed rock, and far into bed-rock, was, in winter, to pick down through the frozen wall or "muck," then build fires in the bottom of the shaft so begun, and shovel out the gravel so thawed until bed-rock was reached. At the bottom of the shaft so sunk fires were laid against the sides of the gravel, and drifts were carried from thirty to forty feet away from the shaft, the ground thawed and mined being

hoisted by handwindlasses and piled in dumps to be washed when the streams began to flow in the spring. In most cases the wood used was hauled to where it was needed by dogs. As the ordinary rate of wages for labor of all kinds was $1 an hour, this style of mining was very expensive, and none but the richest ground would pay a profit over working expenses. The next year thawing by steam was introduced, small boilers were taken to the mines, and used, not only to thaw the ground, but also to operate hoisting engines to raise the pay-dirt mined in the drifts to the surface. Then larger boilers were imported, pumps were set up to pump water, when water by gravity was difficult to obtain, and, finally, pulsometers were installed underground to pump hot water against the face of the gravel, and thus thaw the pay-dirt with hot water instead of with steam. While at first this underground mining was all done in winter, now, with the use of steam or hot water it can be done either in winter or in summer, and, if in the latter season, the pay-dirt can be mined, hoisted, dumped from self-dumping buckets into sluice boxes, and the gold washed from it in one continuous operation. During the past summer, most of the men who went to the Yukon were laborers who went with the intention of working for wages and making the best living possible. Many of the old-timers brought in their wives and families, and a spirit of general contentment has taken the place of the grumbling, unrest, and discontent of previous years.

In his report to the Hon. the Minister of the Interior the Hon. James H. Ross, Commissioner of the Territory, points out that the great requirement of the Territory is cheaper transportation. Every reduction in freight rates, every reduction in the cost of living in the Yukon makes possible the introduction and operation of a higher class of machinery and cheaper production of gold. At the present time, ground that could not be worked at a profit a year or two ago can now be successfully mined. It is confidently anticipated that large areas which have already been mined to the full extent that they probably could be at the time they were mined under the then existing conditions can soon be wholly re-worked at handsome profits. Transportation has been the serious obstacle to cheap mining. The expense, not only of getting things into the country, but of moving them from one place in the country to another, has been enormous. Many instances can be furnished where thrice, four, five, and ten times the cost paid for an article at Vancouver or Victoria for getting that article into position on some mining claim twenty or thirty miles from Dawson. He has endeavoured to aid in the cheapening of transportation within the Territory by providing for the expenditure of every available dollar upon the construction of a circle of roads connecting all the important mining creeks with Dawson, which is the centre of supply for the Territory. The road construction has been mapped out on a large scale, with the view of having each year's operations tend towards completion of a general system calculated to meet to the fullest extent the fullest possible needs of the people.

Last year, in this report, I referred to the development of the deposits of lignite on Rock Creek and Cliff Creek. The output of this coal during the year is estimated to have been about 5,000 tons, of a value at the pit of about $50,000. Silver to the estimated value of $125,000 was also won.

The total royalty collected up to 1st July last year, after deducting the exemption allowed by the regulations was $2,192,645.41; of which $596,368.03 was collected during the year ended 30th June last.

Up to July 1st, 1901 there were recorded 24,524 placer claims, 2,793 quartz claims, 16,573 renewals and relocations, and 25,020 assignments of claims. To the same period 59,449 free miners' certificates were issued, producing a revenue of $596,168.62 and during the last fiscal year 12,511 miners' certificates were issued yielding a revenue of $125,861.

Leases now in force to dredge for minerals in the submerged beds of rivers in the Yukon cover 270 miles. The total revenue received for leaseholds up to July 1st, 1901 was $139,655.50 and for the last fiscal year $2,650.

It is further worthy of remark that the general revenue from the Yukon during the year ended 30th June last, viz.: 2,011,311.07 is the largest on record, being an increase of $207,787.01 over 1899-1900. The Government Assay office, established at Vancouver, treated up to 1st January last 465 deposits, representing 57,221 ounces gold of a value of $939,654.41.

As an encouragement to miners to have their gold assayed at this office, the government has passed a regulation by which miners who personally deliver their gold at the office are refunded one per cent. on the net value of the gold upon which they have paid royalty, so that in the case of the rich miners the royalty is reduced to only four per cent.

GOLD DREDGING IN THE YUKON AND ON THE SASKATCHEWAN.

Leases now in force to dredge for minerals in the submerged beds of rivers in the Yukon cover 270 miles and in the North West Territories 911.75 miles. The total revenue received by the Dominion Government for dredging leases in the Yukon up to 1st July, 1901 was $139,655.50 and for the fiscal year $2,650. The total revenue received for the rent of the leaseholds in the North West Territories up to July 1st, 1901 was $20,262.71 and for the past fiscal year $3,000.

On the Saskatchewan gold dredging is emerging from the experimental stage and gives promise of becoming a successful industry. Hitherto, the chief difficulty has been the saving of the fine gold but it is claimed that Mr. Hobson, the manager of the Saskatchewan Gold Proprietary, Ltd., who had two dredges, the Minto and Otter, at work intermittently on the river last season, has overcome this. Mr. McDonald, Chairman of the Universal Corporation and a New Zealand dredging expert of some standing, who has been supervising the operations of the Proprietary company claims that process of mining has centered down to one and one only successful method, that is the ladder and endless chain system.

Dipper dredges have been tried and found too slow; suction dredges have had their pipes cut out and the principle has been abandoned. The ladder and endless chain system has been the only one to prove successful. The Otter, Minto, and Alberta, the three dredges which were worked this summer, were fitted with this style of machinery, but none of them proved entirely satisfactory. The reason of this partial failure was not in the weakness of the principle but in the weakness of the machinery. The machinery had been designed in England by supposed to be competent mining engineers, but was found altogether too weak in parts to do the work which it was called on to do in dredging into solid gravel banks. Thus numerous breakdowns occurred and it was always some weak link in the machinery which was found to have given away. The Minto was launched on 4th of May, but it was not until July that the dredge could be got to work. She was run for only short intervals during the summer, the breakdowns being of frequent occurrence, and at last was condemned with her machinery and laid up for complete overhauling next season. The Otter made by far the best run of the three, though even she did not run like anything of her theoretical capacity. Probably at no time during the season did she run at more than ten cubic yards per hour, bar measurement. Her results would have necessarily have been much larger had she not been forced, through having no coal tender, to work on bars in the vicinity of the town which had been worked over by grizzley miners for the past thirty years.

The Minto worked about 2,000 cubic yards, her machinery being very unsatisfactory, and though much of the gold was lost, through these defects, she is reported to have saved at the rate of 28 cents per cubic yard. With all the dredges the amount of gold washed was not so great as it might be, but the amount of gold saved for each yard of gravel washed was quite satisfactory.

ALBERTA.

The output from the collieries at Anthracite and Canmore were 14,742 and 88,499 tons respectively, a total of 103,241 tons compared with 98,000 tons produced in the previous year. Lethbridge collieries of the Alberta Railway and Coal Co. also show an increase in production amounting to 35,233 tons, the output for the year being 217,034 tons as compared with 181,801 tons in 1900. The selling price of these coals f.o.b. at Winnipeg was $9.00 for Anthracite and $7.50 for bituminous coal.

Although the discovery of a first class coking coal along the line of the Crow's Nest Railway is not new, still nothing had been done towards its development till last summer, when the possibilities of profitable investment appears to have drawn the attention of capitalists to this field. The value of this coal, particularly to Eastern British Columbia where it can be utilized in the reduction of ores can hardly be estimated, while the coal measures are of such great extent that the working can hardly fail in time to be profitable. Mr. H. L. Frank and associates are expending a large amount of money in opening up their property at Blairmore.

ASSINIBOIA.

The production of lignite at Roche Percee will show an increase over previous years it being estimated that quite 43,000 tons were consumed in Manitoba and the Territories as far west as Regina. The selling price of this coal f.o.b. Winnipeg was $3.75; at Melita $2.60; at Brandon $3.20; and at Regina $3.30.

MANITOBA.

Of the large number of quartz claims taken up in 1898, 1899 and 1900 not more than fifty are to-day in existence and little or no development has taken place on any of them. Reference was made last year to the establishment of works by the Manitoba Union Mining Company for the treatment of Gypsum deposits located in the vicinity of the north eastern arm of Lake Manitoba and of the large deposit of natural cement in the Pembina Valley. Returns from the company show that the output of cement was about 5,000 barrels and the output of Gypsum 600 tons, and the management state that this output will be very largely increased during the present year. The price realized for the company's cement f.o.b. cars at Arnold, on the Morris Brandon branch of the C. P. R. is $2 per ton; $13 per ton was realized at Winnipeg for the output of Gypsum. A mill has been erected at a cost of $15,000 and a steamer transports the plaster to Westbournes Delta, the terminus of the Canadian Northern Company's branch line at the southern end of Lake Manitoba.

At Lac du Bonnett, an elaborate brick plant has been established by the Lac du Bonnett Mining Developing and Manufacturing Company to exploit an extensive deposit of excellent clay. It is said that although the present daily output is only 30,000, the machinery has a capacity of 75,000 brick per diem. This deposit has been proved to be of value for the manufacture of brick, vitrified brick and drain tiles.

ONTARIO.

The mineral industry in Ontario made satisfactory, and in some branches, rapid progress during 1901. The chief metals characteristic of the Province are iron, nickel and copper, in all three of which large advances were made in quantity and value of output. The production of iron ore last year amounted to 272,533 tons as against 90,302 tons raised in 1900. The greater portion of the ore was from the Helen mine at Michipicoton owned by the Clergue interests. Search for other ore bodies has been very active. A large extent of "iron ranges" has been located, and energetic prospecting by diamond drills and otherwise is now going on. Sanguine men look for a duplication of the Mesabi and Vermillion ranges in Western Ontario. Three blast furnaces running steadily throughout the year made 116,370 tons of pig iron valued at $1,701,703 as compared with 62,386 tons worth $936,066 in 1900. Steel was produced by the open-heart process to the amount of 14,471 tons valued at 347,280 as against 2,819 tons worth $46,380 the previous year.

The nickel mines of the Sudbury region increased the quantity of their output by 25 per cent. and the value by 130 per cent. The brisk demand and good prices which have prevailed during the year have led to more extensive operations, the matte which is now being produced being of much higher grade than formerly. The latter circumstance accounts for a considerable part of the increased value. During the year the Mond Nickel Company at Victoria Mines put their smelters in blast, and are now turning out an 80 per cent. matte by the bessemer process. The bulk of the production, however, remains at the credit of the Canadian Copper Company, whose low grade mattes are ground, calcined and re-smelted at the Ontario Smelting Works erected by Col. Thompson of the Orford Copper Company, which came into operation during the year. A noticeable feature of the year was the opening of the Creighton mine in the southwest corner of Snider township from which 500 or 600 tons of ore are being shipped daily to the smelters at Copper Cliff. This mine has every indication of proving to be an enormous deposit. The Manitoulin & North Shore Railway extending westward from Sudbury serves this mine as well as several other nickel properties, two of which, the Gertrude and the Elsie, are owned by the Lake Superior Power Company. A considerable tonnage of ore has been raised from these mines, and roast heaps have been inaugurated at the Gertrude of ore from both mines. Smelters are also to be erected there.

The yield of precious metals was somewhat smaller than in 1900, 14,293 ounces of gold worth $244,443 being produced as against 18,767 ounces worth $297,861 the previous year. The Mikado, Sakoose and Sultana mines in northwestern Ontario have remained steadily at work, and about the beginning of 1902 were joined by the Black Eagle, formerly the Regina, where a new thirty-stamp battery has been installed. In eastern Ontario the Deloro and Belmont mines have been doing good work. The production of arsenic at the former has also been greatly increased.

The yield of silver was 151,400 ounces worth $84,830 as against 160,612 ounces valued at $96,367 in 1900. Consolidation has recently taken place by which the West End, Porcupine, Badger, East End and Keystone mines have passed under the control of a new company. It is expected to undertake large operations and increase the present output.

The out-put of non-metallic minerals shows a small increase in value over 1900, the total being $6,785,791 as against $6,733,338. There was a decided increase in building materials, and a falling off in petroleum. The other principal items remain at pretty nearly the same level The decrease in petroleum is partly due to the natural diminution in the output, which is about five per cent. less than in 1900, and in part to the fact that a larger proportion of crude than formerly is now used for fuel and in the making of gas. Natural gas also fell from $392,823 to $336,183. The decrease was partly due to the stoppage by the Ontario Government of the export from the Essex field to Detroit, which took place near the close of the year.

The making of cement is now assuming considerable proportions in the Province the out-put being 489,288 barrels as against 432,154 barrels in 1900. Some complaint is made of American competition and the out-put, though larger, was a little smaller in value, being estimated at 670,880 as against $698,015.

Carbide of calcium was produced to the value of $168,792 as compared with $60,300 in 1900. Corundum worth $53,115 and arsenic worth $41,677 were also notable products.

The results of the year have been to demonstrate the importance and value of the mining industry in the Province, and were such as to lead to sanguine expectations for the future.

I am indebted to the courtesy of Mr. Gibson, the Dtrector of Mines, for the following table showing the

MINERAL PRODUCTION OF ONTARIO FOR 1901.

PRODUCT.	1900.		1901.	
	Quantity.	Value. $.	Quantity.	Value. $
Metallic:				
Copper..... lb.	6,728,000	319,681	9,074,000	627,080
Gold ..... oz.	18,767	297,861	14,293	244,443
Iron Ore .....tons.	90,302	111,805	272,538	174,428
Nickel . . .. lb.	7,080,000	756,626	8,882,000	1,731,650
Pig Iron ....tons.	62,386	936,066	116,370	1,701,703
Silver..... ..... oz.	160,612	96:367	151,400	84,830
Steel ....tons.	2,819	46,380	14,471	347,280
Zinc ore .....tons.	500	500	1,500	15,000
Total Metallic		$2,565,286		$4,926,379
Non-Metallic:				
Arsenic.....lbs.	606,000	22,725	1,389,056	41,677
Building Materials—				
(Brick,stone,lime,etc.) tons.		2,688,351		3,034,854
Carbide of Calcium .....tons	1,005	60,300	2,771	168,792
Cement ..... bbls.	432,154	698,015	489,288	670,880
Corundum . . .. lb.	120,000	6,000	1,068,000	53,115
Petroleum.....Imp. gals.	23,381,783	1,869,045	21,433,500	1,467,940
Natural Gas		392,823		336,183
Salt .....tons.	66,588	324,477	60,327	323,058
Other Products		671,602		689,292
Total Non-Metallic.....		6,733,338		6,785,791
Add Metallic		2,565,286		4,926,397
Total Production		$9,298,624		11,712,188

QUEBEC.

The production of asbestos was the outstanding feature of the year in Quebec, the total value of the output being estimated to have been not much short of a million and a half dollars, the largest in the history of the industry. Three modern and splendidly equipped milling plants were installed at Thetford Mines, three at Black Lake, and one at Broughton. Seven companies operated all the year round and three others intermittently, occupying a force of about 1500 men. It is expected that with no change in the market twelve companies will be in operation in 1902 requiring a force of at least 2000 men. The other mineral products of the Province were iron ore, chromite, mica, felspar, copper pyrites, galena, burnt ochre, barytes, phosphate, and building material.

NEW BRUNSWICK.

Mining in New Brunswick was mainly confined to the production of copper, manganese, gypsum and building materials. A small quantity of coal was also won. At Dorchester the Intercolonial Copper Company mined 40,000 tons and have installed a first-class mining and treatment plant.

NOVA SCOTIA.

Mining progress in Nova Scotia was again chiefly remarkable for the continued and very gratifying expansion in the production of coal, coke, iron and steel. As already stated the total output of coal for the twelve months was in excess of 3,800,000 tons an increase of quite 500,000 tons over the production in 1900 and a result very largely, if not entirely, brought about by the operations of the Dominion Coal Company which raised 2,561,783 tons as compared with 1,999,737 tons in 1900. This company delivered 863,633 tons to St. Lawrence ports; it exported about 600,000 tons to the United States, principally for gas and coke-making; and the balance of its production practically went to the Sydney steel works.

The Dominion Iron and Steel Company has now its furnaces and convertors running and this enterprise will very shortly be operating on a large scale, which means, unless some untoward change takes place in the trade that we are assured of a very material increase in our coal consumption during the present year. The output of the Province for the year was reduced by something like 70,000 tons of American coal purchased for the Intercolonial Railway.

The Nova Scotia Steel and Coal Co., have continued their regular operations at the Sydney Mines Pit, and have completed the construction of an up-to-date coking plant. They are engaged now in building a new shipping pier, and in opening the Lloyd's Cove seam.

In Inverness County considerable progress has been made in development. The Port Hood Colliery has been placed on a good footing for shipping coal. At Broad Cove, the development of that field has been steadily advanced in a substantial manner by the Inverness and Richmond Collieries and Railway Company.

American capital has taken hold of the Mabou district, and is preparing to win the submarine areas.

In Pictou County the only development of note has been the opening of one of the Marsh seams by the Nova Scotia Steel & Coal Co. It is stated that the coal from this opening is specially adapted for use in the convertors of the Company, and that the entire output of the mine will be absorbed for this purpose.

In Cumberlaed County the development of the Springhill reserves of coal has been continued in a satisfactory manner, and the collieries have been overhauled and refitted in every respect. Much interest has been taken during the year in explorations in the other districts of the Province yielding indications of the presence of coal. The Provincial Government acquired some time ago five drills, two of these were of the "Calyx" pattern, and have proved very successful. The other drills are the Bullock pattern, two being hand-drills, and the other a steam drill. These drills have been licensed to parties in various parts of the Province for prospecting for various minerals, and have proved highly successful. The results of explorations in the new coal fields appear, as far as carried out, to give proof of the presence of a number of seams of coal of good quality, and as a rule of about the thickness of the smaller seams worked in Cumberland County.

The following returns of the output of the various collieries during the twelve months have been compiled from figures furnished to me by the managers:—

COLLIERY RETURNS 1901.

Dominion Coal Co	$2,561,783
Cumberland Railway and Coal Co	411,000
Acadia Coal Co	270,253
Nova Scotia Steel and Coal Co	237,184
Intercolonial Coal Co	204,402
Canada Coals and Railway Co	68,055
Gowrie and Blockhouse	20,700
Port Hood Coal Co	20,000
Cape Breton Coal Co	13,534
Inverness and Richmond	13,500
Sydney Coal Co	8,949
Other, estimated	5,000
	$3,834,360

COKE MADE.

Dominion Iron and Steel Co	192,873	tons.
Acadia Coal Co	11,738	"
Intercolonial Coal	5,305½	"
People's Light and Heat Co	8,480	"
Nova Scotia Steel and Coal Co	23,540	"
Total	241,936	tons.

PIG IRON AND STEEL MADE.

Dominion Iron and Steel	pig iron	111,014 tons.
Nova Scotia Steel and Coal Co	"	26,793 "
do do	steel ingots	25,678 "

Gold Mining in Nova Scotia has practically remained stationary, the output being about 31,000 ozs.

The Richardson, Blue Nose, Brookfield, and most of the other regular producers report satisfactory yields. A number of new mines have been opened; but in a number of cases further work has shown that they cannot be depended on for permanent outputs.

The most encouraging feature of gold mining in the Province is the preparation heing made to open the Dolliver Mountain district by a strong American syndicate. This lies on the same belt as the Richardson, and is believed to present even larger beds of medium grade ore. An up to date mining and milling plant is being installed by this company.

The gold and silver contents of the ores of the Cheticamp River in Inverness county have contined to attract the attention of the Cheticamp Mining Company, and it is reported that they are now able to effect a classification of the lead and zinc ores of that district, so as to put them in a marketable concentrated shape. The result of these operations will be watched with much attention for there are numerous indications in that district of the presence of mineral deposits of auriferous copper and lead ores.

The production of pig iron as stated was 137,807 tons. The only company carrying on iron ore mining operations was the Nova Scotia Steel and Coal Company, which mined about 18,000 tons at Bridgeville, Pictou County.

A little over 418,000 tons of Bell Island ore were imported for the furnaces at Sydney and at Ferrona. Ore was also imported from the United States, Spain and Cuba.

The explorations for iron ore were not marked with much spirit. A little work was done on the Whycocomagh deposits which resulted in tracing beds of ore still further north. The explorations completed at Nictaux in Annapolis County have shown clearly the enormous extent and great value of the iron ores of that district.

The remainder of the mineral production of Nova Scotia continued much as in previous years. The export of Gypsum was about 136,000 tons in addition to small quantities used locally for fertilising and architectural purposes.

The production of limestone was about 100,000 tons largely used for the furnaces at Sydney and Ferrona.

A few hundred tons each of Barytes and Infusorial earth were reported from various points.

The exploitation of the copper ores of Cumberland and Colchester Counties is being continued. At present a smelter is being erected near Wentworth with a capacity of 25 tons a day. At Cape D'Or, in Cumberland County, the Colonial Copper Company has done a lot of preliminary work on beds in the trap carrying metallic copper. It is stated that the indications are promising for a rich and extensive deposit.

The CHAIRMAN—I would call the attention of the members to the enormous amount of work entailed in getting these figures together by our Secretary (applause).

After some discussion by Messrs. Ingall, the Secretary, Chairman, and others, on the various methods adopted in Canada of computing values, and the necessity of adopting a greater uniformity in the dates of publication of statistics by the Provincial and Dominion Governments, the meeting adjourned at 5.30.

TUESDAY EVENING SESSION.

The members assembled at eight o'clock, Mr. Cornelius Shields, General Manager of the Dominion Coal Co., occupying the chair.

GOVERNMENT AID TO MINING.

Mr. C. SHIELDS, in taking the chair, expressed his pleasure at meeting the members of the Institute. It was a great honor to preside over such a distinguished gathering, particularly on the occasion of the discussion of such a question of so much moment as Government aid to Mining. The proposal to establish a Dominion Department of Mines, was a move in the right direction, one which had already been too long deferred.

Mr. J. E. HARDMAN then introduced the question in an excellent address, reproduced elsewhere in full in this issue. He dwelt upon the national importance of mining and of the urgent necessity of the establishment at Ottawa of a Department which would give special attention, not only to economic geology, but to the various phases of mining and metallurgical development which had of late years assumed a leading position in the industrial progress of the Dominion.

Dr. F. D. ADAMS—The question, "How may the government of a country promote the interests of mining and the development of its mineral resources?" is one which may find various answers according to the character of the country and the financial position of the government.

In every civilized country of the world at the present time there is a national geological survey, and the principal and avowed aim of these surveys is the development of the mineral resources of their respective countries. That is to say it is the universal opinion among the civilized peoples of the world that geological surveys are of practical benefit to them.

The law establishing the United States Survey provides that the Director shall have charge of the Mineral resources and products of the national domain." Now we in Canada are blessed with a very extensive national domain and comparatively limited financial resources, and the question which faces us is how can we best with the means at our disposal set about developing our mineral wealth.

I believe the most effectual way in which the government can do its share towards this development consists in increasing the efficiency of, and, if necessary, entirely remodelling an institution which we already have and which in times past has done good work for the Dominion. I refer to our Geological Survey, and would like to point out certain ways in which the efficiency of this valuable institution could be increased and the services which it renders to the country be made of more direct practical value.

The first and chief aim of all national geological surveys is the preparation of a good geological map of the country. On this is shown the distribution of the various rocks which form the earth's crust in these countries, and the position and distribu ion of all known mineral deposits. These maps also show the connection of the mineral deposits in question with certain geological formations, and hence, the distribution of the formations in question being shown, the areas in which additional occurrences are to be sought. This aeral mapping has been carried on for years by the Geological Survey of Canada and a considerable part of the more settled portion of the Dominion has been mapped. The value of many of these maps has been very widely recognized. I might cite as samples: Lawson's Geological Maps of the Lake of the Woods and the Rainy River District, which were of immense value in the development of that region; the maps by Dr. Geo. M. Dawson, of various portions of British Columbia, and Mr. Fletcher's maps in Nova Scotia.

This work should be continued until we have a good geological map of all those portions of the Dominion which are worth surveying geologically.

I believe, however, that this work, which occupies the greater portion of the

staff of the Geological Survey of Canada, might be carried out in a much more efficient manner than it is at present. We have to remember in the first place that in Canada there are no topographical maps. The township maps, issued by the Crown Lands Departments of the various Provinces, consist of a series of lot and range lines with a few lakes and streams indicated where they cross, or sometimes where they do not cross, the lines in question. They are innocent of all delineation of roads, hills, etc., not to mention contour lines. Some of these maps are tolerably accurate so far as they go, while others are intolerably inaccurate. When an attempt is made to put a series of these township maps together they cannot be made to fit. Like the Gentiles, each is a law unto himself. Further trials also await the man who, having compressed a series of these maps into compact form, endeavors to hang them unto the proper projection. He will find that this is, in almost every case, impossible. In the case of a map which Dr. Barlow and I recently made for the Geological Survey of Canada, of a large district in Central Ontario, it was found impossible to ascertain within four miles the position of one of the principal villages in the area, and special lines of transit survey had to be made from the Georgian Bay to Kingston to determine the precise location of this and other points upon the projection.

Now, in order to show the geological structure of any district, a good topographical map is absolutely necessary, and the geologist, with us, has to make it for himself. When, therefore, he undertakes the geological survey of any district he is obliged to spend, let me say three-quarters of his time in doing topographical work and one-quarter of his time in geological investigation. This is manifestly a great waste of time and money, for the geologist, who commands a higher salary than the topographer, spends most of his time doing topographical work which generally he cannot do as a well as a specially trained topographer, while in some cases a man who is really a topographer is selected to make the survey and his geological work is accordingly of very indifferent quality. The general rule that a man cannot do two things well at the same time governs here, although for years the Canadian Survey have been endeavoring to show that it does not hold. In their case we may safely say that the exception proves the rule.

When we turn to the geological surveys of other countries we find that they employ a separate and distinct class of skilled topographers, who go into the area first and make a topographical map which is then handed to the geologist who uses it as the basis for his work. In order to make the Canadian Survey more efficient this plan should be adopted. The regular field staff should consist of two sections:—(1) topographers, and (2) geologists. The former class should be the more numerous and would not command such high salaries as the geologists. Each class would thus be enabled to do its work thoroughly and well and I venture to say that under this arrangement the geologists would accomplish much more work than they can do at present, and the geological maps *could be prepared and published more rapidly*, thus avoiding the delay in issuing maps of important areas, which is in many cases at present unavoidable. Under this plan of working moreover we would have in the case of every area surveyed, not only a good geological map but a good topographical map, which would have a value of its own for many diverse purposes.

The "folio" exhibited shows how the work of the United States Geological Survey is carried on in this direction. The country is divided up into quadrangles, which vary somewhat in size according to the circumstances of the case; and the survey of these quadrangles is taken up in the order of their relative economic importance. When the survey is completed the information which has been collected is presented in four maps, as follows:—

1. The topographical map of the area, which is uncoloured.
2. The geological map.
3. A second geological map, giving special prominence to all occurrences of deposits of special economic value.
4. A map with geological sections crossing it in certain lines which bring out clearly the geological structure of the area in question.

These maps are accompanied by a short explanatory text. These "folios" form part of the great geological and topographical map of the United States now in course of construction. Some fifty of them have been already published and they now appear at the rate of about ten per annum. I was informed recently by the Director of the United States Geological Survey that there was not a single important mining area in the United States from which he had not had applications asking that the necessary surveys be made and one or more of these folios issued for the districts in question.

Now, while in Canada we cannot undertake to do work so rapidly as this and while this precise form of publication is probably not the most suitable for us, we can certainly obtain many hints from these folios of the United States Geological Survey which will enable us to improve our Canadian maps.

There is another class of work which should be undertaken by the Canadian Geological Survey, and which would be of the greatest practical value to the country. This is "Mining Geology," and consists in the preparation of detailed reports or monographs on certain limited areas where mineral deposits of great economic value are known to exist. These reports should be accompanied by geological maps on a large scale, and should embody the results of as complete a study of the area as is possible, in which all resources of modern knowledge are brought to bear upon the problems presented, and comparisions drawn with foreign areas of similar character, from the development and working of which much valuable information bearing on the areas surveyed could often be obtained. The reports should be clearly written, in language "understanded of the people," so that they would be of direct practical value to all interested, either in the area in question or in mineral deposits having the character of those described. Prompt publication of such economic work is specially imperative, for its value as an aid to development decreases with every day and almost every moment of delay. As districts worthy of such study one might mention, among many others, the Copper-Nickel district of Sudbury, the Chromic Iron Ore district of the Eastern Townships, and the Iron Ore regions of certain portions of Ontario. How many camps in British Columbia would, during the past two or three years, have profited by such special study, and how many would even now profit by it?

For this work I believe geologists of special fitness and training should be selected, who might or might not be permanently connected with the Staff of the Survey. With proper assistance from the Topographical Staff and the Chemical Department, the work should go rapidly forward. It might frequently be found advantageous to secure the services of outside geologists or mining engineers, especially competent to report upon certain classes of mineral deposits, *e.g.*, coal, manganese, graphite. For special pieces of work the men on the Survey staff engaged in this work should form a distinct class of Mining Geologists and especial prominence should be given to their work.

The addition of these Mining Geologists to the staff and the vigorous prosecution of this class of work by the survey is the chief innovation needed to make the work of this Department tell, as it should, in the development of our mineral resources. In connection with this class of work, the Survey could with great advantage arrange to co-operate with the Universities and so make use of the unusual facilities offered in the ore dressing and metallurgical laboratories of the Canadian Mining schools for the purpose of making concentration and other tests such as are now being regularly carried out in these laboratories, on ores, etc., from various portions of the Dominion.

Concerning the duties of the Survey in preparing annual mineral statistics, I will say nothing, not because this matter is not of importance, but because it has already been so well emphasized by Mr. Hardman. The Statistical Department should, however, extend its work and make itself of still further value to the country by publishing, at frequent intervals, bulletins on the Mineral Resources of Canada—as, for instance, one on the Iron Ores of Canada; others on Canadian Coal Fields; Canadian Asbestos Deposits; Canadian Clays, Building Stones, etc.—in which the information scattered through the various reports and thus not available as a whole to inquirers, would be gathered together, brought up to date, and published in convenient form. This Department should in fact undertake all the functions of a Bureau of Mines and Mineral Resources. For the satisfactory and economic working of the Survey, furthermore, the Chemical Department should be entirely reorganized.

The staff of the Survey would thus consist of the following classes of officers: (1) Mining Geologists; (2) Field Geologists; (3) Topographers; (4) Chemists and Assayers; (5) The offices of the Bureau of Mines and Mineral Resources. There would also be the Petrographer, the Palæontologists, the Accountants, the Museum staff, etc.

I believe, then, that the Government has in the Geological Survey the nucleus of a department which might render the most important and valuable assistance to the mineral history of the whole Dominion. The Survey however, needs to be *reorganized and extended*, and converted into a "Department of Mines and Geological Survey." (Applause.)

In my humble opinion, moreover, the establishment of a Department of Mines separate from the Geological Survey would be unwise. The aims, and to a great extent, the work of both departments would be identical. The work above outlined could be carried on by a single bureau far more satisfactorily, for no line of division between the two could be drawn. Neither a Geological Survey nor a Department of Mines could by itself attain its full measure of usefulness, and if two separate Departments were created there would be a continual overlapping of work, which would lead not only to confusion but to waste of time and effort, and loss of efficiency. Lack of proper co-ordination in the various classes of work, which is one of the weak points of the Geological Survey at present, could be entirely prevented by making one strong, well-organized department, which would undertake all the various sorts of work that the Government should be called upon to do in the interests of our mining industries. (Applause.)

Mr. W. Blakemore—It is not my intention to take up much of your time, but I desire to follow up what has been so ably said by the previous speakers with a resolution to the following effect: "That the Canadian Mining Institute, in annual

session assembled, desires to direct the attention of the Federal Government to the magnitude and importance of our mining industry, which during recent years has developed so rapidly, and respectfully urges the increase of Government aid wherever possible, and the establishment of a strong and practical Department of Mines, believing that nothing will do more to develop the natural resources and promote the general prosperity of Canada." Now, I question that any gentleman who does not attend our meetings knows the magnitude of our mining industry—We have heard from the report of the Secretary, that the mineral production reached seventy millions of dollars. Now just for a moment let me call your attention to this fact, that only 20 years ago the total mineral production was not a great deal more than the single item of copper or nickel, and that will show you with what leaps and bounds it has gone forward. Let me make this suggestion, there is no impropriety in our endeavouring to impress the Government with the magnitude of the industry we represent and asking them to do more than they have ever done before on that account. (Applause.)

Mr. B. T. A. BELL—Before the motion is put to the meeting perhaps I may be permitted, as one who has been actively associated with the mining industries of this country for a period of some seventeen years, to emphasise the necessity of the establishment of a Department of Mines entirely separate and distinct, if need be, from the present Geological Survey, a Department whose chief aim shall be to give to the public more complete and more frequently published statistics of our mineral production, accurate and up-to-date monographs of mining districts and mining industries and information of a more commercial character than we have hitherto been able to obtain either from the Federal or Provincial Governments. The remarkable expansion of mining as an industry in Canada and its immense importance to the trade and commerce of the Dominion are not fully realized by the people of this country. It is significent that out of our mineral production last year, amounting to over seventy millions of dollars, the great bulk of our output was exported. My own idea is that greater prominence must be given to the commercial and business aspect of our mining industries, that one of the chief aims of a well equipped and capably administered Department of Mines would be to collect and furnish, not merely periodically in its reports, but on demand, the latest available data concerning the development and progress of our mining industries. Business men, capitalists enquiring into industries for the purpose of investment, require official data of a business character and the Government should be able to supply them with it. More attention should be given to such questions as the capital invested in our mines, the dividends paid, cost of extraction and treatment, labor, machinery equipment, mining and metallurgical practice, markets, freights, and the numerous other questions of a commercial nature which people desirous of placing money in an industry naturally desire to obfrom an official source. By combining the technical with the industrial and commercial, by employing a competent staff of economic geologists and topographers, together with a corps of first-class mining engineers a Department of Mines will do much to advance the development of the great mineral resources of the country. (Applause.)

Dr. ROBERT BELL—I would like to say a few words not only upon the Geological Survey but upon the remarks of the gentlemen who have preceded me. There seems to be an impression that we are not practical. The Geological Survey was instituted to do practical work and it has done so since the moment I have been connected with it. I began a little more than a boy and I have travelled and worked from Nova Scotia to the McKenzie River, from the Rockies of British Columbia to Baffin's Bay, until I have come to be regarded as a sort of living index to the younger fellows of the work of the Survey. Sir William Logan was a practical man and did practical work and we have endeavored to do that ever since. I am glad that some suggestions have been made wherein the work of the Survey might be improved. I have always said that more should be done in the direction of economic geology and we have tried to do so far as we could. Dr. Adams has pointed out the importance of topographical work preceding the Geological Survey ; that is all very well if the Government would undertake it. We are obliged to do topographical work simultaneously with the geological work. Dr. Bell then referred to the work done by McConnell in the Yukon, by Gwillim in Atlin, by Brock in the Boundary, by McEvoy, in the Crow's Nest Pass, by Low, and other members of the staff. I don't want anything more practical than the work of these men. We want science first and business after. I had almost forgotten about the chemical branch ; we have good chemists and they are very hard working men. Dr. Hoffman goes back to his laboratory every night and his heart is in his work. I think our chemical work is done well. Altogether we are doing, I think, excellent w[illegible] on behalf of the country.

Mr. B. T. A. BELL—Just a remark—The object of this discussion is not to criticize the Geological Survey, for we all recognize the value and importance of that excellent institution. We do, however, urge upon the Government the necessity of a Department of Mines which will give to the public more information of practical utility to business and mining men than hitherto has been available from any Government source.

Mr. BLAKEMORE—When I made use of the words practical men I did not as Dr. Bell has done refer to him as a California saloon keeper. I think that in any mining department whether attached to the Geological Survey or not there should be attached permanently or in an advisory capacity a first-class mining engineer with a practical experience in mining.

Mr. EUGENE COSTE—I think it was in 1884, if I remember correctly, that a Parliamentary Committee investigated this question and made a report to the Government the outcome being the establishment of the present Mines Branch of the Geological Survey to which Mr. Ingall and myself were appointed. It has been said here to-night that it has not been the fault of the Geological Survey if foolish investments in mines have been made. I differ somewhat from this view. Of course there will always be foolish speculations in mines, as in other matters, but if at that time the Geological Survey had done what the Parliamentary Committee of the House of Commons had recommended it to do and Mr. Ingall and myself had been given a free hand to carry out and develop the work of that Mines Branch I am not so sure but that many of the foolish investments might have been prevented. Although appointed mining engineer in charge of the Branch I was not given a free hand and finding it impossible to carry out the work as I conceived it ought to have been done, I sent in my resignation. There is no question now that a properly equipped mining Department should be organized with a competent staff of mining engineers, economic geologists, topographers and sasayers. So far the Federal Government has not appreciated the magnitude and importance of the mining industries of the Dominion. They have, until recently taken no steps to inform themselves upon their necessities and requirements. Had there been a properly constituted Mining Department at Ottawa I venture to say there would have been no shch bungling in the mining regulations adopted for the Yukon. When that great gold field was discovered they were taken by surprise, they had no one to advise them, regulations were made and changed every week and for that matter are being changed yet, creating no end of dissatisfaction in that country. Now if the Government had had in its service a first-class mining engineer to advise them questions of this charaeter would be greatly simplified. There is no doubt the Government should pay more attention to the mining industries and organize a proper Mining Departmen', either in connection with the Geological Survey or out of it, but it must be organized and established on a thorough business basis. (Applause.)

Dr. EUGENE HAANEL—I came here rather to listen than to speak, nevertheless, I have been very deeply interested in the papers that have been presented,—ably and well done. The one point that has presented itself to me from the discussion is that a Department of Mines is an absolute necessity for the mineral development of Canada and I am exceedingly sorry that Mr. Sifton could not be with us to hear what you have said, but he was ordered to go South. I think my report to him will encourage him on this subject and greatly strengthen his hands.

Mr. J. C. DREWRY—I am not a member of the Geological Survey nor a Mining Engineer, nor a practical man from California, but as one trying to make an honest dollar in mining out there in British Columbia. I am very glad to be here. We all acknowledge that the work of the Geological Survey is good but it could be made better and more practical—that is the word to use—and I hope that Mr. Sifton will go on and establish a Department of Mines—swallow up the Geological Survey if necessary—but at all events go ahead and give us an institution that will be practical and useful.

Mr. B. T. A. BELL—Would it not be well to adjourn this discussion until to-morrow afternoon ?

Mr. EUGENE COSTE—Can't we get through to-night ?

Mr. HARDMAM—As the seconder of the resolution I would say that we expect other members from a distance to-morrow and it might be well to give them an opportunity of discussing the resolution.

Dr. J. B. PORTER—Mr. Drewry has just suggested that the Department of Mines might possibly swallow up the Geological Survey and Dr. Adams has suggested that we should dwell at more length upon the extreme importance of the Department of Mines being subordinate to the Geological Survey. Now it seems to me that this is immaterial but it is essential I think that both should be operated under one head. Let us not double the Bureas but rather have one do the whole thing.

Mr. B. T. A. BELL—I would suggest that the resolution be remitted to a Committe consisting of Messrs. Shields, Hardman, Coste, Dr. Bell, Dr. Goodwin, Blakemore, Dr. Adams and Professor Miller, and that their report be presented at to-morrow afternoon session.

Mr. JAMES MCEVOY—While the Geological Survey is doing good work still there is room for improvement and we might suggest improvement along the lines of the United States Geological Survey.

Mr. C. SHIELDS—It seems to me that the action of the Meeting should be clearly set forth in one resolution and it is possible that the one we have before us might be improved—might be made much stronger.

Mr. B. T. A. BELL—Then moved the appointment of the Committee. Carried.

The meeting adjourned at 10.30 p m.

WEDNESDAY AFTERNOON.

The members reassembled at three o'clock, Mr. John E. Hardman, S.B., M.A.E., presiding.

CIVIL ENGINEERS' BILLS.

The CHAIRMAN—The Committee appointed to examine and report upon the Canadian Society of Civil Engineers Bills present the following resolution:—

> *Resolved* that the Canadian Mining Institute having examined and considered the Civil Engineers Bill now before the Ontario and Manitoba Legislatures is of the opinion that this Act should not be passed since it gives powers to the Canadian Society of Civil Engineers which should not be given to any one branch or section in the present condition of the engineering profession. Such powers should be retained by the Government itself or reserved for a society or association representative of the whole profession.

The Committee also suggests that action relative to the proposed Bill in B.C. be placed in the hands of the Secretary with power to act in the premises.

(Signed) JOHN E. HARDMAN.
DR. W. L. GOODWIN.
WM. BLAKEMORE.
E. COSTE.

The resolution was then put to the Meeting and adopted.

NATIONAL IMPORTANCE OF MINING.

The CHAIRMAN—On behalf of the Committee to which last evening you remitted Mr. Blakemore's resolution, I have to report that we have been in session all morning but have been divided upon two resolutions, the one by Mr. Blakemore and an amendment to it proposed by Mr. Coste adding the words "and which shall include the present Geological Survey and all necessary branches".

Mr. Coste seconded by Dr. Adams moved the adoption of the amendment.

Mr. Blakemore, seconded by Mr. J. C. Drewry moved for the adoption of the original motion.

Mr. Jas. MCEVOY—We should have more in these resolutions. The Geological Survey should be reorganized and it would be advisable, it seems to me, to clearly specify to the Government the lines upon which this reorganization could be made effective.

Mr. EUGENE COSTE—In support of my amendment I would only say that we must recognize existing conditions and I feel that we should not be too radical in our recommendations. The Geological Survey already exists and any new Department of Mines should, in my opinion, include the Survey.

Mr. INGALL—As a Government officer do you understand either resolution to mean the abolition of the Survey?

The CHAIRMAN—The resolution as I understand it does not interfere with the Geological Survey at all. The motion brought up last night is one for a recommendation to the Government for an entirely different department devoted to mining alone. Therefore, answering Mr. Ingall's question, I can't see for my own part why the Survey has anything to say or is in any way connected with this resolution asking for a Mines Department.

Mr. BLAKEMORE—Replying to Mr. McEvoy I do not think it would be wise at this stage to introduce any details into the resolution.

Dr. W. L. GOODWIN—The difficulty I find with Mr. Blakemore's resolution is that it recommends the establishment of a Department—a new Department of Government.

Mr. B. T. A. BELL—That is just what it means and that is just what we want.

Dr. GOODWIN—Just so; but the Government may not regard so large a scheme as practicable from their point of view. On the other hand Mr. Coste's resolution leaves to the Government the establishment of a Bureau devoted to mining and the other branches that would be necessary, in such a way that would conveniently fit in with existing conditions. I think the Survey should be mentioned in our resolution because it would be unwise to disconnect the work that the Geological Survey is doing which is the scientific basis of mining. I would suggest a Department of Mines and Geology, which would represent all branches coming within the purposes and powers as employees of the Government.

Mr. GEORGE CAMPBELL—I, for one, do not believe in half measures. We have Departments of Marine and Fisheries, of Agriculture and of Labor, why not have a Department of Mines?

Dr. ADAMS—The basis of a Department of Mines should be the Geological Survey. If Mr. Blakemore's resolution goes before the Government they will say the Mining Institute does not consider the Geological Survey to be of any value to the country and to the Department of Mines. Now we do consider the Survey to be of value to the country and to the Department of Mines. A former speaker has compared the Departments of Mines with that of Agriculture and Fisheries but the analogy is not quite appropriate. Mineral lands are owned by the Provinces—the Federal Government has no control of mines in the Dominion.

Mr. B. T. A. BELL—Yes they have—What about the Yukon and the Territories?

Dr. ADAMS—When these Territories become Provinces, as they will ultimately, the mining lands will pass from the Dominion into their control, as at present in the older provinces.

Mr. B. T. A. BELL—I see we have with us to-day our old friend Captain Adams one of the pioneers who, eleven years ago, promoted the organization of the Quebec Mining Association out of which our present Institute has evolved. I am sure I voice the sentiment of everyone present when we welcome Captain Adams back again to our meetings. Perhaps he has something to communicate to the discussion!

Captain R. C. ADAMS—I am very much surprised at the kind illusion made to me in asking me to address the meeting. I regret to say that I am not in very good health and am not prepared to make a speech. I am, however, heartily in favor of a Government Department or Bureau which will classify and concentrate the information concerning mines collected by the Provinces.

The CHAIRMAN having called upon Mr. T. W. Gibson, Director of Mines for Ontario.

Mr. T. W. GIBSON—Not having been present last evening I am not acquainted with the lines of the discussion but from what I have gathered from the remarks of the speakers this afternoon it seems to be merely a difference of opinion as to details. Whether the establishment of a Department of Mines with a responsible Minister, or a sub-department which should include everything connected with the mining industry—which of these methods will be the better is not easy to decide—but I would like to bring this point before the meeting that in working out a scheme the Government must take into consideration what is being done by the Provincial Governments. The mining lands in all the older Provinces are the property of the Provincial Governments and the laws governing them are made by the Provincial Legislatures. Hence in a scheme of this kind, while I am not at all desirous of opposing anything that the Institute may suggest, care will have to be taken that the work of any new Department or Bureau does not conflict with the operations of the Provincial Governments. It will interest the members to know that the output from our mines in Ontario last year has grown to a value of twelve millions of dollars as compared with nine millions of dollars in the year 1900. (Applause).

Mr. JAMES MCEVOY—I think we might overcome the difficulty by using the words "*A* Geological" instead of "*The* Geological Survey". (Laughter).

Captain ADAMS—I would ask Mr. Bell what a Department of Mines will do more than the Geological Survey does now?

Mr. B. T. A. Bell—I am afraid Captain it would take me three or four full sessions of the Institute to do that satisfactorily. (Laughter).

Prof. T. L. WALKER—I think I am right in maintaining that geology is a wider subject than mining. If the Geological Survey is to fall from its present position to that of a subordinate branch of a Department of Mines that would be a step backward.

Dr. ROBERT BELL—There is a great deal of force in what Professor Walker has said and all I can say is if you can't do us any good don't do us auy harm.

Mr. B. T. A. BELL—I would call the attention of the Chair to the irrelevancy of this discussion. We are discussing the question of a Department of Mines with which, at this stage, in my humble judgment, the Geological Survey as an institution has nothing whatever to do.

The CHAIRMAN—I am anxious to confine the discussion to the question. We are not dsscussing the Geological Survey we are simply asking for greater recognition of the mining industry. The relation of the Geological Survey to a Department of Mines is a matter of expediency which may very well be left in the hands of the Minister of Interior and the Government. We say to them—these are our views give the mining industry a show.

MR. EUGENE COSTE—We have discussed this matter for sometime now and I am emphatically in favor of embodying in the resolution the reference to the Geological Survey. In doing so we do not say that we want the Survey to occupy an inferior position. The words have been put there to show the Government that it is necessary to have not only a Geological Survey but a topographical and all the other branches in order to make a Department of Mines complete and efficient. Why not say it in plain words? I think it will help matters.

Dr. ROBERT BELL—This is a very important matter. I agree with what Mr. Coste has said. He has been a member of the Geological Survey staff and appreciates us but I think in the way he puts it he does not appreciate us. In the United States the Geological Survey is supreme and most comprehensive and includes a Division of Mines and Mineral Statistics.

Mr. BLAKEMORE—Having withdrawn his resolution the Chairman put the amendment, moved by Mr. Coste seconded by Mr. Blakemore as follows:

> *Resolved* that the Canadian Mining Institue in Annual Session assembled desires to direct the attention of the Federal Government to the magnitude and importance of our mining industry which during recent years has developed so rapidly and respectfully urges an increase of Government aid

wherever possible and the establishment of a strong and practical department of mines or of a department which shall be devoted to the interests of the mining and metallurgical industries and which shall include the geological Survey and all other necessary branches.

The motion was carried by a large majority.

NOTES ON GOLD MILLING AT REPUBLIC WASHINGTON.

Mr. Fritz Cirkel presented an exceedingly interesting paper. He described the ores of the Republic District in Washington and their peculiarities. He then referred to the various systems of treatment which had been tried, closing with a description of the large mill erected by the Republic Mining Company upon the designs of Mr. Jackling.

WEDNESDAY EVENING.

The members reassembled at 8 o'clock in the Ladies Ordinary there being a very large attendance.

Prof. W. G. Miller opened the session with a paper describing the "Varied Mineral Resources of Eastern Ontario". He referred to the iron mines, the newly-opened corundum mines and other resources of the country. This paper—of which we hope to represent an abstract later—was illustrated by a number of maps and photographs presented by means of lantern slides. In conclusion Prof. Miller said that Ontario was producing as great a variety of mineral substances as any part of the world of equal area, while as a whole Canada had a record as a mineral producing country of which she might justly be proud.

ILLUSTRATED ADDRESS ON THE YUKON.

After the conclusion of Prof. Miller's paper, Mr. F. B. Wade, of Dawson, addressed the Institute, by invitation, on mining in the Yukon. Mr. Wade was one of the pioneers in the first great rush to the Klondike, and was for three years chief law officer of the Dominion in that territory. In his address he adopted the method of contrasts, showing both verbally in his address, and by a large number of fine lantern slides, the different state of affairs in the North four years ago and to-day. The Chilkoot Pass in the first rush and the passenger train on the Yukon and White Pass Railroad—the roughly built barge of the prospector and the Yukon River steamer—the Dawson of tents and the brick-built city of to-day—with numerous similar contrasts of to-day, all effectively brought out by the photographs.

Unfortunately, however, Mr. Wade added, the Yukon had had the same experience as all the other mining camps in Canada, that at the outset, at any rate, it had to a certain extent failed to attract Canadian immigration. This, however, was commencing to correct itself, and he believed that the Census would show that, though somewhat tardy, the Canadian was commencing to take an interest in the country and to share in the patrimony to which he was entitled. He spoke of the great gold output of the Klondike, and of the rapid growth of Dawson, which, four years ago, was only a place of a few tents, and to-day showed an assessment of $12,000,000. It was sincerely to be hoped that the time was not far off when Canadians would wake up to the fact that the Klondike was growing, and that the young man who went out today into the world to fight his way was in a very different position from the young man of a few years ago.

To one point especially the speaker referred with justifiable pride, and that was the excellent order preserved in the region and the absence of violence and lawlessness, which have been only too prevalent at Nome and in other mining districts which might be mentiened. This was largely due to the admirable organization and handling of the Northwest Mounted Police, a force of which Canada has just reason to be proud.

Mr. Wade expressed, in conclusion, his belief that the next excitement in the Yukon will be in quartz mining. Already there are many quartz locations, and two stamp mills are in operation on custom work, chiefly on test runs. The general opinion in the district is that the gold in the creeks has not been carried far, but has been very probably derived from the quartz ledges crossed by the streams, which are visible in many places in the form of narrow stringers. There are, he believes, many indications that intelligent prospecting will show substantial grounds for this opinion, and that quartz mining and milling will be prominent in future operations. At any rate, the gold industry of the Yukon promises to take on a permanent form, and to be an important factor in the mining industry of Canada for a long time to come.

At the conclusion of Mr. Wade's address a vote of thanks was unanimously passed, and the Institue adjourned until the next day.

The meeting adjourned at 11 o'clock.

THURSDAY MORNING SESSION.

The session opened at eleven o'clock in the Library, Mr. Hardman in the Chair.

OFFICERS AND COUNCIL FOR 1902.

The Scrutineers, who had previously examined the ballots, reported the election of the following Officers and Council for the ensuing year :—

PRESIDENT.

Mr. Charles Fergie, Intercolonial Coal Co., Westville, N.S.

VICE-PRESIDENTS.

Dr. Frank D. Adams, McGill University, Montreal.
Mr. Robert R. Hedley, Hall Mining and Smelting Co. Nelson.
Mr. Eugene Coste, M.E., Prov. Nat. Gas and Fuel Co., Toronto, Ont.
Mr. Graham Fraser, Nova Scotia Steel and Coal Co., New Glasgow, N.S.

COUNCIL.

Mr. John B. Hobson, M.E., Con. Cariboo Hydraulic M. Co., Bullion, B.C.
Mr. Frank Robbins, M.E., North Star Mining Co., Nelson, B.C.
Mr. W. F. Little, H. W. McNeill Co. Ltd., Anthracite.
Mr. Frederick Keffer, M.E., B.C. Copper Co., Anaconda.
Mr. Cornelius Shields, Dominion Coal Co. Sydney, B.C.
Mr. R. E. Chambers, M.E., Bell Island, Newfoundland.
Mr. W. L. Libbey, N. Brookfield, N.S.
Mr. D. W. Robb, Robb Engineering Co., Amherst, N.S.
Mr. A. P. Turner, Canadian Copper Co., Sudbury, Ont.
Mr. P. Kirkegaard, Canadian Gold Fields Ltd., Deloro.
Mr. E. A. Sjostedt, Lake Superior Power Co., Sault Ste. Marie, Ont.
Professor Courtenay DeKalb, Boston, Mass.
Mr. J. T. McCall, Canada Iron Furnace Co., Montreal.
Mr. B. Bennett, King Bros., Thetford Mines, Que.
Dr. J. Bonsall Porter, McGill University, Montreal.
Mr. George R. Smith, M.L.A., Bell's Asbestos Co., Thetford Mines, Que.

TREASURER.

Mr. J. Stevenson Brown, Montreal.

SECRETARY.

Mr. B. T. A. Bell, Editor *Canadian Mining Review*, Ottawa.

LOCAL BRANCHES OF THE INSTITUTE.

Mr. B. T. A. Bell suggested a resolution in favor of organizing local sections of the Institute in the various mining centres of the Dominion. He explained that if his plan was adopted the sections would be organized under the charter and by-laws of the Institute; their members would be members of the Iustitute; and papers presented at the meetings would be regarded as Institute papers and find full record in the volumes of the proceedings. He further explained that the object of this plan was to interest many who were unable to attend the Annual Meetings owing to the long distances to be travelled. Moreover, the local sections would be able to hold more frequent meetings, at such intervals as they might decide for themselves and thus create and maintain an interest which would be of value to the Institute generally and also to local mining.

The recommendation was generally approved and the following resolution presented by Dr. W. L. Goodwin was unanimously adopted :—

"That in view of the great extent of the Dominion and the long distances to be travelled by many members in order to attend the meetings of the Institute, it is expedient to organize local sections in mining towns and camps and other centers, and the Council is hereby empowered to take such action as is necessary to carry out this recommendation".

THURSDAY AFTERNOON.

The Meeting was called to order at 3.30 p.m. Papers illustrated by lantern projections were presented as follows :—

On the Iron Ores of Hudson Bay.
By Prof. G. R. Mickle, Toronto.
On the Iron Ores of Kitchener, B.C.
By Wm. Blakemore, Fernie, B.C.
On Gold Dredging.
By Dr. J. Bonsall Porter, Montreal.
On the Electro-Metallurgy of Copper Nickel Ores.
By Wm. Koehler, Cleveland, Ohio.

These papers and the discussion upon them occupied the whole of the afternoon.

ANNUAL DINNER.

At eight o'clock eighty members and their guests sat down to an excellent menu provided by the Windsor Hotel. A capital instrumental and vocal programme was presented, the intervals being interspersed with very brief speeches in response to a limited number of toasts. A thoroughly enjoyable gathering broke up about twelve o'clock.

FRIDAY MORNING.

A brief business session was held in the Library of the Institute on Friday morning. On motion it was decided to award a gold medal to be known as the Institute's Gold Medal for the best paper contributed to the proceedings of the Institute during the year. A deputation comprising Messrs. Hardman, Brown, Bell, Adams, Coste, Kirkgaard, Dr. Goodwin, and others was appointed to present to the Government the resolution respecting the organization of a Department of Mines.

The proceedings terminated with votes of thanks to the Chairman and to the Treasnrer and Secretary.

NEW COMPANIES.

ONTARIO.

New York and Ontario Gold Mining Co., Limited.—Incorporated 28th February, 1902. Authorized Capital, $1,000,000; in shares of $10.00 each. Head Office :—Kingston, Ont.

English River Gold Mining Co., Limited.—Incorporated 28th Feb., 1902. Authorized Capital, $1,000,000; in shares of $1.00 each. Head Office :—St. Catherines, Ont.

COMPANY NOTES.

Le Roi.—Returns for February :—" 18,794 tons of ore were shipped to the Northport smelter, containing 6,111 ozs. of gold, 12,461 ozs. silver, and 300 tons copper. Gross value (reckoning copper at 16 cents per lb., as in former monthly returns), $225,696; average value, $12.00 per ton. Taking yesterday's New York quotation for copper, namely, 12 5-16 cents per lb., reduces the averages value to $10.83 per ton."

Ymir.—Cablegrams.—" For the second half of last month, level No. 10, 50 feet; main shaft, 19 feet." Office note.—This makes the total length of the tunnel at this date 2,084 feet, and the depth of the shaft 713 feet.)—Later advice: "Have commenced to operate cyanide process."

Le Roi No. 2.—The manager cables :—" Rossland, 5th March—Shipments last month amounted to 3,630 tons, containing 2,042 ozs. of gold, 4,885 ozs. of silver, 94 tons of copper. Estimated net profit, after deducting all smelting and mining charges, $22,800." (Office note.—The decrease in the amount of tonnage shipped is due, in the first place, to February being a short month; and, secondly, to the fact that the power plant was shut down for five days for repairs.)

Velvet Rossland Mine.—Cable received 28th February gives the following first returns from smelters :—"69 tons yielded 69 ozs. gold, 75 ozs. silver, 8,472 lbs. copper, wet assay. Gross value, $2,442, or an average of $35.39 (£7 1s. 6d.) per ton. Net proceeds, $1,500.23, or an average of $21.74 (£4 7s) per ton, after deducting smelters' charges. Crosscut to the west at 500 feet level is now in 64 feet."

Bosun Mines.—Telegram from the manager reports 160 tons galena and 100 tons zinc shipped during the month of February. Smelter returns for 160 tons, $5,344.

The Whitewater Mines.—The following cablegram has been received from the company's representative at Nelson, British Columbia :—" During last month 5,700 tons have been milled, producing 474 tons of concentrates. Approximate profit on month's working is $210 (£43)."

Arctic Slope Hydraulic.—At a meeting held on 10th December last, the following were elected directors for the present year :—Hon. F. Peters, Hon. Senator Reid, Quesnel, Capt. William Grant, William Munsie, A. Stuart Robertson, C. T. Penwill and F. W. Vincent. The directors afterwards met and elected Hon. F. Peters, President, Capt. Grant, Vice President, and Donald Fraser, Secretary. The new Board of Directors have made an entire change of management, and appointed Mr. J. H. Munroe, hydraulic superintendent for this season. Mr. Munroe has had considerable experience as a hydraulic miner, and started for the company's mines in Omenica on the 20th ultimo. Last year a considerable quantity of gold was recovered, but very much larger results are expected this season.

CONSOLIDATED CARIBOO HYDRAULIC.

The following is excerpted from the report of Mr. J. B. Hobson at a meeting of the shareholders held in Toronto on 23rd January last :—

The mine was operated only 104 days 1½ hours, with a quantity of water varying from 2,000 to 2,750 miner's inches, being 67 days 12 hours less than the season of 1900, when the water supply was sufficient to keep the mine in operation for a period of 171 days, 13½ hours.

The shortness of the water supply was caused by the unusually light winter snowfall and the hot, dry weather that prevailed during the spring and summer months. The season's mining operations were divided into two runs, as follows :—

Washing was commenced on the Upper Bench in Pit No. 1 on the 20th day of April, and was continued for a period of 88 days and 20 hours, ending on the 31st day of July. During the progress of the run 217,677 miner's inches of water were used to wash out 2,202,126 cubic yards of top clay, gravel and sliderock from the main bank and rims of the channel deposits, from which was recovered 6,664 ounces of gold, valued at $113,452.17, an average yield of about $5\frac{15}{100}$ cents per cubic yard, and a daily product of $1,289 22. The duty attained for the water used was $10\frac{36}{100}$ cubic yards per miner's inch. Washing operations were confined to the removal of the top deposits, with the exception of 66 hours' washing on the Lower Bench, when water was used to remove the broken rock excavated while lowering and advancing the main bedrock sluice out to make the grade necessary for the removal of the gravel from the Lower Bench to the dumps. The increased duty attained for the water used was owing to the thoroughly disintegrated condition of the indurated top clay capping and hard top gravel deposits lying on the rims, produced by the three bank blasts successfully exploded during the winter and spring. The small product secured for the run was owing to a falling off in the yield of the gravel on the east side of the channel, caused apparently by a short turn of the east rim to the west, which continued at an angle of about 40 degrees for a distance of about 150 feet up stream. This sharp turn induced a crossing of the current in the ancient stream from west to east, which eroded under and caused immense slides of bed-rock to fall from the east rim into the ancient channel, that replaced the high-grade deposits found so continuous before the deposit of slide-rock was encountered. The inclusion of so large a mass of barren slide-rock and low-grade deposits during the run was disappointing, but not discouraging; for it is well known that such cross-currents and accompanying low-grade deposits are of common occurrence in all ancient and modern streams, and are usually followed by higher grade stratified gravels, deposited on the bars and benches formed above such current crossings.

The second run, commenced on the 4th day of August, included a period of 16 days 5½ hours, ending with the exhaustion of the water supply on the 29th day of August.

During the progress of the second run 40,573 miner's inches of water were used to wash from the Upper Bench 215,036 cubic yards of clay gravel and slide rock, from which was recovered $1,687\frac{75}{100}$ ounces of gold, valued at $28,821.34, an average yield of $14\frac{33}{100}$ cents per cubic yard, and a daily product of $1,835.12. The duty attained for the water used was about $5\frac{3}{10}$ cubic yards of gravel per miner's inch. The falling off of the duty of water below that of the first run, resulted from the inclusion of a large quantity of broken rock removed from the slide deposit. The complete removal of the deposit of slide-rock and the great improvement in the value of the deposits as the workings were advanced up the stream, explains the cause of the increased daily product for the run.

During the progress of the season's operations, about 3,126 cubic yards of gravel from the Lower Bench was washed through the main cut and sluice section No. 1, from which was recovered coarse gold, amalgam and nuggets valued at $3,978.00, an average yield of about $1.27 per cubic yard of gravel washed. This product is included with that of the previous runs.

Had the water supply been sufficient to carry the season's operations to the 1st of November, the product for the season would probably have reached a figure equal to, if not larger, that of the season of 1900.

ROSSLAND GREAT WESTERN.

At the first annual meeting of the shareholders held in London a few weeks ago the Chairman, in referring to the business of the Company, said :—"A reference to the table on page 15 of the report will show you that the work of extraction of ore was only carried on for one hundred and seventeen days out of a period comprising some four hundred and fifty days. With regard to the strike and its origin and the manner in which it was successfully combated by Mr. Macdonald, the Le Roi shareholders were given a lucid and very fair account by Mr. Hill, the Chairman of that Company, at its meeting on Friday. Probably most of you have read it, and I need not therefore, travel again over ground with which you are perfectly familiar. I notice at that same meeting a statement was made that this company was liable for a profit wrongfully made out of stores sold to Le Roi mine. I do not think for a moment that that claim can be substantiated. I shall be glad to render any explanation in my power after I have done with regard to any item either in the balance sheet or in the profit and loss account upon which further light is wished by anyone present. In the meantime I may say, turning to the balance-sheet, that the item on the debtors' side £265,17s. 1d. sundry creditors, is made up of payments to lawyers here and in Rossland for professional services and a payment to the Le Roi Company of £85. The large amount of £24,051 on the same side due in Rossland comprises £11,000 due to the Northport smelter, and £9,600 due to the Le Roi Mining Company, also £2,150 due to the bank at Montreal for loans, which have since been paid off. The same is the case with the bill payable to the Bank of Montreal £4,123. On the credit side of the balance-sheet there is a small item of £257 for a town lot on the Great Western and another on the Nickel Plate. Sundry debtors include about £13,600 due in London and £5,800 in Rossland, a total—to be exact—of £19.480 3s. 9d. The whole of this, with the exception of £1,700 has since been paid. There does not appear to be any item in the profit and loss account which requires further explanation. With regard to the future of this property it must be clear to you from Mr. Macdonald's report that it must largely depend upon the value of the ore to be exposed on and below the 600 ft. level, and bearing upon this question Mr. Macdonald informs me that the shaft sunk on the Great Western proves that the south vein of the Le Roi runs right through the property. Owing, however, to the swampy nature of the ground in the neighborhood of the Great Western shaft and the consequent expense of keeping it in repair, it is not intended to use it, but to run a drive from the 600 ft. level to the Nickel Plate through the Golden Chariot and the Great Western, thereby exploring the vein between these points, a distance of about 2,000 ft. Having regard to the fact that your property lies within the recognized limits of the mineral belt, the belief is warranted that when your mine is fully developed it will be a profitable producer. Mr. Macdonald is present in the room and will be pleased to answer any questions you may put to him. To this very short and rather bald statement I only want to add a few words of personal explanation. I understand from the tenor of the circular that you would very much like me to retire from this Board. I shall only be too pleased to go off the Board if that is your wish. I may say that as a Board we have endeavored during the last six months unsuccessfully to obtain practical mining men upon this Board as our Colleagues, but it is not so very easy to do that when a mine is going down hill and not up. All I would beg of you to do is to consider carefully before you make what is classically called a clean sweep. Do not make it so clean as to include everybody who is familiar with the affairs of the company. In that remark I am referring to my colleague, Mr. Dealtry, who has worked preservingly at this mine. Although I do not want to leave this Board. if you think my services are of any good, I trust the shareholders will continue the services of Mr. Dealtry, the secretary and Mr. Macdonald. As a matter of form, I now propose that the reports and accounts be received and adopted ".

Mr. A. B. Dealtry seconded the motion.

CROW'S NEST PASS COAL.

The fifth report to the Directors covering operations for the year ended 31st December last shows :—

The net profits for the year after paying all operating expenses, and all charges of every kind at head office and mines, amounted to $270,848.39. This amount has been derived from the various departments of the Company's business, viz : the sale of coal and coke, from waterworks, house rents, electric light, etc. After paying dividends at the rate of ten per cent. per annum a balance of $28,142.89 has been carried forward to credit of profit and loss.

During the year the Company has issued $500,000 new stock (under the authority of supplementary letters patent dated 19th February, 1901,) at a premium of sixty per cent. and $300,000 premium paid in was also added to profit and loss account, making a total sum at credit of that account (including the amount already there from the earnings of 1900) of $517,-017.41.

The Directors are pleased to state that the Company's operations are progressing most satisfactorily under the management of an efficient staff. They have reason to expect still more satisfactory results will be shown at the end of the present year.

SULTANA MINE OF CANADA.

The Directors herewith submit the Balance Sheet and Profit and Loss account for the period from the 1st October, 1900, to 30th Sept., 1901.

During the year £12,161 16 1 has been spent at the Mine as follows :—

Mine Development	£3,100 12 0
On Buildings, Boats, Assay Plants, Mine Equipment and Electric Light, etc.	564 13 11
Working Expenses in Canada charged to Profit and Loss Account	8,496 10 2
	£12,161 16 1

During this period gold has been won to the value of £8,186 17 10, made up as follows :—

Per Mr. Strong's Report	$36,329 95	
Bullion credited by Bank on 2nd Oct. not included in Mr. Strong's Report	1,516 78	
Proceed of concentrates	1,614 10	
	$39,460 83 at 4.82 equals	£8,186 17 10

The Directors regret that their anticipations of good returns from the ore body at the south shaft referred to in the last report have not been realized, for some time payable quartz was won, but it became gradually lower in value and was abandoned for the time being. Disappointed here, the Directors, acting on the advice of the Manager decided to concentrate their efforts on locating the faulted ore body. This as is shown in the Managers Report enclosed herewith, they are hopeful, has been accomplished.

The Shareholders will, no doubt, remember that in October an issue of 5,000 Preference Shares of £1 each was made on certain terms and conditions, nearly 4,000 of these shares have been applied for and with the funds so obtained the Direstors are driving the seventh Level North East, with a view to proving the existence of the ore body as located by the diamond drills. Definite information should be received from the Mine about the end of April. In the meantime, two drills are engaged stoping ore above the third Level, and the mill will be put into operation on day shifts early in January, 1902.

COLONIAL COPPER COMPANY.

This Company, now engaged in erecting an extensive copper mining and smelting plant at Cape D'or, Bay of Fundy, Nova Scotia, has issued the following statement of its finances as at 31st., December last :—

Assets.

Mines, Real Estate and Property (Including all Property, together with improvements, machinery, buildings, etc.)	$ 10,000,000.00
Treasury Stock (885,569 shares)	885,569.00
Furniture and Fixtures	1,477.30
Accounts and Notes Receivable	173,984.64
Cash	43,914.32
	$ 11,104,945.26

Liabilities.

Capital Stock	5,000,000.00
Accounts Payable	3,815,76
Surplus	6,101,129.50
	$ 11,104,945.26

During the past year we have sold 203,832 shares of the Treasury Stock, on which we realized $292,727.25, leaving a balance of 885,569 shares on hand. Our accounts receivable and cash on hand December 31st, 1900, as in last year's balance sheet, amounted to $89,676.35. By adding to the latter the receipts for the past twelve months, and deducting from the result $217,898.96 (present cash and accounts receivable) shows a gross expenditure of $164.504.64 for the year.

The disbursements at the mines for salaries, machinery, tools, buildings, land purchased, supplies and incidental expenses of all kinds, amount to $154,280.56. The New York office expenses were $10,224.08, which includes rent, salaries paid to officers and employees, printing, advertising, express, postage, together with all sundry and incidental items.

Referring to the matter of liabilities, our accounts payable at the close of the fiscal year amount to the nominal sum of $3,815.76. This comprises sundry items which could not be audited and paid prior to closing the books. It has been the managements policy since the organization of this corporation to pay cash for everything, thereby saving all cash discounts, and enabling us in every instance to buy at much lower prices than we could on time purchases. This fact must be an additional assurance to those financially interested, as without debts we can supply our first earnings to the payment of dividends.

ST. EUGENE CONSOLIDATED.

The following is a statement of the financial affairs of this company, covering the operations for the year ended 30th September, 1901 :—

Assets.

Mines and Mineral Claims		$3,200,000 00
Cash in Banks—		
Bank of Toronto (Rossland)	$105,741 45	
" " (Toronto)	4,093 00	
		109,834 45
Machinery, Buildings and Equipment—		
Compressor Plant	$13,954 24	
Boiler Plant	6,477 57	
Concentrator Plant	42,862 88	
Air Lines	11,693 24	
Tramways	11,911 31	
Machine Drills and Fittings	5,121 97	
Mine Buildings	14,440 15	
Offices and other Buildings	13,698 68	
Flumes	19,708 78	
Cars and Rails	10,135 86	
		150,004 68
Stores on hand		27,168 41
Toronto Office Furniture		307 23
Accounts Receivable		10,465 87
Capital Stock Discount		134,100 00
		$3,631,880 64

Liabilities.

Capital Stock		$3,500,000 00
Accounts Payable—		
War Eagle Con. M. & D. Co.	$2,145 97	
T. G. Blackstock	4,375 00	
		6,520 97
Profit and Loss		125,359 67
		$3,631,880 64

Profit and Loss Account.

To Cost of Mining and Development—		
Labor and Supplies	$213,129 95	
Compressor Labor	5,090 16	
Compressor Supplies	7,309 06	
Machine Drills and Fittings	7,492 36	
Tramway Expense	5,411 41	
Salaries	8,196 64	
Office Expense	2,388 01	
Assay Office Expense	1,825 93	
Surveying	1,180 79	
Concentrator Expense	34,236 93	
Sundry Expense	1,628 93	
		287,889 86
To Amount written off for Depreciation—		
In Plant, etc		20,019 12
To Travelling Expenses		511 50
" Interest and Exchange		2,522 70
" Legal Expenses		436 88
" Mine Accidents		113 00
" Taxes		12,210 02
" Insurance		1,185 50
" Consulting Engineer's Fees		1,100 00
" Auditor's Fees		155 00
" Trail Smelter Examination Expenses		2,670 79
" Managing Director's Salary		4,375 00
" Capital Stock Discount		14,900 00
		$384,962 80
To Dividends Nos. 1 and 2	$210,000 00	
" Balauce carried forward	125,359 67	
		335,359 67
		$684,322 47
By Balance brought forward		124,909 03
" Ore Sales (20,020 tons)		556,040 11
" Rents		3,351 58
" Transfer Fees		21 75
		$684,322 47

CANADIAN GOLD FIELDS SYNDICATE.

The following is excepted from the report to the Directors submitted at a meeting held on the 4th ultimo :—

During the year 1901, mining in British Columbia was carried on under most trying conditions, namely : serious labor troubles, excessive freight and treatment charges on lead ores, and the remarkable fall in price of both lead and copper. That the industry has been able to survive these troubles and difficulties, is but an additional proof of the wonderful extent and richness of the mineral deposits of that Province.

In December 1900, the English price of lead was £18 per ton. The present price is £10 16s, or considerably below the average price of the last twenty years. Present indications are that the price will again advance within the next few months.

One great drawback to the profitable mining of silver and lead ores, has been the fact that the smelters charged an excessive freight and treatment rate, and shipped all of the smelter product out of the country to be treated in foreign refineries. The Dominion Government have recognized the burden under which the industry was laboring, and have granted a measure of relief (altogether too little in my opinion) in the way of a bounty for the production of pig lead from ores mined and smelted in Canada, extending over a period of five years. This has induced the C.P.R. to begin the erection of a lead refinery in connection with their smelter at Trail, B C., which they expect to have ready for operating about the middle of May, 1902. The British Columbia smelters have announced a reduction in freight and treatment charges of from three to four dollars per tou on silver lead ores, taking effect January 1st, 1902.

It will thus be seen that the situation has materially brightened within the past few weeks. I confidently expect to see it still further improved and expect in the early spring to see the St. Eugene concentrator operating to its full capacity earning dividends for the stockholders of the St. Eugene Consolidated Mining Company Limited, in which the Canadian Gold Fields Syndicate Limited, are interested to the extent of 640,000 shares.

Dividends.—In spite of the adverse conditions referred to, we have been able to pay our stockholders two dividends or three per cent. each during the year 1901, amounting to $35,746.68. These dividends were earned before the price of lead went down to the present low figure.

The Slocan Sunset.—The bond on the "Sunset" property, near Whitewater, B.C., which was taken in June 1900 was thrown up on March 31st, 1901. Continuous development work had been carried on in the interval and about 53 tons of high grade ore was taken out and shipped. The ore was very bunchy and finally pinched out, so the bond was thrown up. It is to be regretted that the "Sunset" property in no way justified the report made by the Company's Mining Engineer. His connection with our company ceased on April 1st, 1901.

The Commonwealth Group.—But little work was done on the Commonwealth Group during 1901. Owing to the adverse conditions previously referred to I deemed it advisable to curtail our operations. A tunnel was driven 126 ft. on the Commonwealth vein ; a new trail made to the upper workings and a comfortable cabin 16x20 ft. erected near the mouth of the upper tunnel. The new tunnel cut through the top of an ore chute about 40 feet long and from 2 to 4 ft. wide, of a good grade of ore, but the tunnel had not reached the ore chute towards which it was being driven, when work was suspended for the season. The Canadian Gold Fields Syndicate Limited, own 400,000 shares out of the 700,000 issued shares of the Commonwealth Mines, Limited, leaving 800,000 shares still in the treasury of the Company.

The True Blue.—Work on the properties of the True Blue Copper Mines, Limited, near Kaslo, B.C., has been steadily carried on since March 1901, with very gratifying results. A good ore chute of very high grade copper ore, is now baing opened up on two levels. The pay or chute in the upper level is 16 inches wide but on the intermediate level it has widened to 4ft. The cross-cut tunnel has intersected the vein on the third level showing it to be 15 ft. wide, but the ore chute has not yet been reached. The cabins on the property have been repaired and put in good condition ; a large ore sorting house has been erected at the mouth of the lower tunnel ; a new trail has been made from the property to Kaslo, and four of the claims have been surveyed and applications fyled for Crown Grants. Two car-loads of high grade copper ore are now en route to the smelter, and the smelter returns will be known within a few days. There are at least ten car loads of similar high grade ore, blocked out in sight. All of this has been accomplished on an expenditure of $7,500.00 of which the Canadian Gold Fields Syndicate Limited, has only furnished $5,000.00 the balance being the proceeds of the sale of 50,000 shares of True Blue Stock to the business men of Kaslo. Further development work should be done on the True Blue Group, as the property is now one of proved merit. I believe that our investment in the True Blue Copper Mines, Limited, will not only re-coup us for our loss in the Slocan Sunset, but will make us a substantial profit. It will be necessary, however, to have further funds to carry on the work in order to put the property on a paying basis, but the present good showing of ore abundantly justifies going ahead with the work. As soon as the returns have been received from the ore now en route to the smelter, an opportunity may be presented the stockholders of the Canadian Gold Fields Syndicate, Limited, to purchase shares of the True Blue Copper Mines, Limited, at five cents per share, to the amount of 250,000 shares. This would provide a fund of $12,500 which will be spent exclusively on the further development of the True Blue Group and I believe will result in putting that property in a position to justify the erection of an aerial tram and the beginning of regular shipment. The aerial tram would result in a saving of about $4 00 per ton in the marketing of the True Blue ore. It will be rembered that the True Blue Copper Mines, Limited, is incorporated under the laws of British Columbia with an authorized capital of $150,000 00, divided into 1,500,000 shares of a par value of 10 cents each. Of this about 750,000 shares have already been issued leaving 750,000 shares still in the treasury of the company. The Canadian Gold Fields Syndicate, Limited, own 390,000 shares, or a little over 50 per cent. of the issued capital of the company. It is highly desired that the Canadian Gold Fields Syndidate, Limited, and their friends, should continue to hold control of the True Blue Company so as to direct its management and protect our large and valuable interest.

Sunset No. 11.—No work was done on this Group of properties during 1901. I am of the opinion that an arrangement can be made with English capitalists to take over our Rossland properties, forming an independent company with ample working capital. I am working on the details of such a plan and in a short time will submit the whole matter to your consideration.

"Jennie and Eldon" Mineral Claims.—No work has been done on either of these claims during 1901.

St. Eugene Consolidated Mining Company Limited.—Ourholdings in this company still stands at 640,000 shares of the par value of $1.00 each. Owing to the low price of lead, and that fact that none of the Canadian smelters could handle the output, the St. Eugene concentrator was only operated for about five months in 1901. During that time about 11,000 tons of silver lead concentrates were shipped mostly to Antwerp. The St. Eugene Consolidated has paid two dividends amounting to $210,000.00 and at the end of their financial year had a cash balance on hand of $125,359.67. The Canadian Gold Fields Syndicate, Limited, received $38,400.00 in dividends from the St. Eugene Consolidated ; while our holdings in that company only cost us $145,448.23. It will thus be seen that the investment was a highly profitable one, as it yielded us a return on our investment of over 25 per cent. for 1901. Development work has been steadily carried on all through the year, and there are now over 200,000 tons of ore blocked out in sight in the mine. A shaft has been sunk for a distance of one hundred and forty feet (or over sixty feet below the level of Moyie Lake), and there is no water to bother or interfere with the work. A level is being driven 125 ft. below the collar of the shaft and in a short time the big ore chutes already opened up in the tunnels above, will be developed on this new level. This will practically double the amount of ore in sight. These ore chutes have already been proved to a depth of 300 ft. by diamond drills so it is merely a question of doing the work to block out the ore. The St. Eugene Consolidates continues to justify the claim made for it—that it is one of the biggest lead mines in the world. The concentrator has been still further improved so that it now has a capacity of 425 tons per day. Owing to the improved conditions it is confidently expected that the St. Eugene Consolidated will resume shipments at an early date.

WINDERMERE DISTRICT.

This winter has been marked by steady progress in the mines of this district. Whilst there is nothing notable to record we learn that the various properties are shewing up in a manner satisfactory to their respective owners and justify more attention to this district than capitalists have so far accorded it.

No large shipments of ore will be made from any of the mines as on account of the unsatisfactory condition of the metal market at present only such ore has been taken out as has been encountered in the course of opening up the properties.

Your correspondent estimates that the amount of ore to be forwarded to the smelters when navigation opens in April will be as follows :—

From the Paradise Mine	150 to 200	tons.
" McDonald Creek Mines	80 to 100	"
" Delphine Mine	70 to 80	"
" M.T. Mine	30 to 40	"

Most of this ore is now at the Columbia River awaiting the steamers' arrival.

A Gold Dredging Record —The establishment of the gold-dredging industry in New South Wales has been attended by many bitter disappointments and much financial loss, the bulk of the public flotations having been disastrous failures. This notwithstanding, a number of companies have demonstrated that on certain watercourses and with plants adapted to local conditiors, gold dredging can be carried on profitably. Four of the public companies have reached the dividend-paying stage. Among these the Aralaen Central is quoted by the Sydney "Daily Telegraph" as a conspicuous success. For some time past this dredge has held the record for Australia, and in one week recently working short time (110 hours), it recovered 165½ oz. gold, thus eclipsing its previous best return of 152 oz. When the fact is considered that there is almost sufficient clear profit in this return to pay a 6d. dividend on 10s. shares, it will be recognized that the shareholders have one of the few prizes among many blanks.

MINING ENGINEER.

WANTED—Position by Mining Engineer with 20 years practical experience in charge of iron and coal mines in England. Surface and underground work ; boring, sinking, and developing ; erection of machinery ; management of men, etc. Holds English Government certificate as Colliery Manager.

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Molly Gibson.—Shipments this year have been as follows :

1902	Tons.	Assay Value.	Freight and Treatment.	Nett Value.	Average Net Value per Ton
January....	266	$11,392 15	$2,790 80	$8,601 35	$32 34
February ..	447	16,232 33	4,184 91	12,047 42	26 99
Total....	711	$27,624 48	$6,975 71	$20,648 77	$29 04

The Number Five Tunnel is now in 200 feet beyond the cross-cut, making 450 feet in all. This work is being pushed as rapidly as possible. Cross-cutting to the parallel vein will be begun shortly, when shipments will probably be augmented.

WANTED
FOR A LIBRARY.

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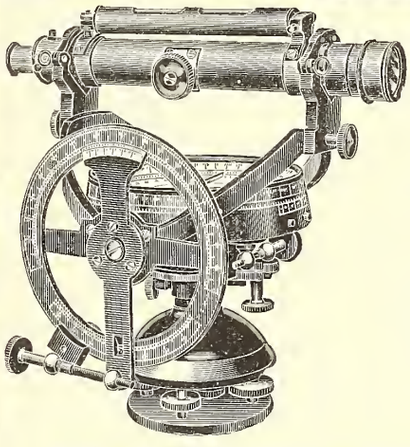
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Next Session begins October 3rd,

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FOR CALENDAR OF THE SCHOOL AND FURTHER INFORMATION APPLY TO

Dr. W. L. GOODWIN,

DIRECTOR

SCHOOL OF MINING, KINGSTON, ONTARIO.

Did You Hear the Thunder?

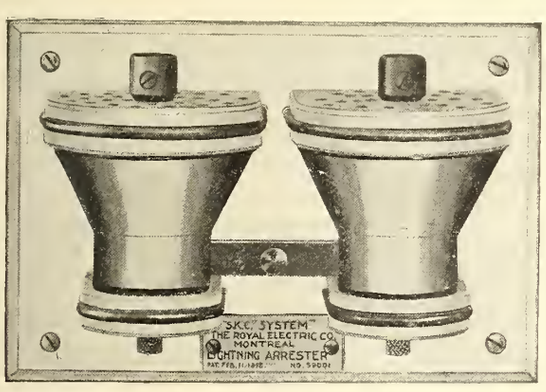
Where there is thunder there is lightning. Every electric plant should be provided with Lightning Arresters which will **PROTECT!**

NOW

IS THE

TIME

.Write for Bulletin No. 904..



MANUFACTURED AND SOLD BY

The Canadian General Electric Co., Limited,

Head Office: TORONTO, ONT.

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THE

Canadian Pacific Railway

IS THE MOST DIRECT ROUTE TO THE

Great Mining Regions

OF

British Columbia, the Yukon and Alaska.

DAILY
TRANSCONTINENTAL
SERVICE
between the
Atlantic and Pacific Coast
THROUGHOUT THE YEAR.

COMMENCING JUNE 15, 1902,

the IMPERIAL LIMITED trains, crossing the continent in 97 hours, will leave Montreal and Toronto for Vancouver every Sunday, Wednesday and Friday, June to October.

First-class Sleeping and Dining Cars attached to all through trains.

Quickest route to the Yukon via the C. P. R. to Vancouver, C. P. N. steamships to Skagway and White Pass Railway and connecting steamers to Dawson.

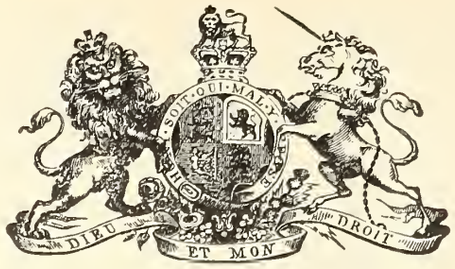
Magnificent fleet of steamers in the inland waters of Southern British Columbia by which all important points, not connected by rail, can be reached.

For rates, reservation of berths, etc., apply to nearest C. P. R. Agent or to

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Eastern Lines,
MONTREAL.

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General Passenger Agent,
Western Lines,
WINNIPEG, Man.

ROBERT KERR,
Passenger Traffic Manager,
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PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

PROVINCE of QUEBEC

The attention of Miners and Capitalists in the United States and in Europe is invited to the

GREAT MINERAL TERRITORY

Open for investment in the Province of Quebec.

Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at the mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order in Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's Certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50 00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end on the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 an acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee $5.00 renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed in the river below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent. on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River and Hill Claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer Claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim, and each person in his or its employment, except house servants, must hold a Free Miner's Certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of five per cent charged on the gross output of the claim, with the exception of an annual exemption of $5,000 00.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek or gulch, but the same miner may hold any number of claims by purchase, and Free Miners, not exceeding ten in number, may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch or river, by giving notice and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00 and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette.*

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, and a royalty of five per cent. on the gross output, less an annual exemption of $25,000.00 are charged. Operations must be commenced within one year from the date of the lease, and not less than $5,000 must be expended annually. The lease excludes all base metals, quartz and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite : copper in sulphide and native form ; gold, mostly in free milling quartz ; silver, native and sulphides ; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

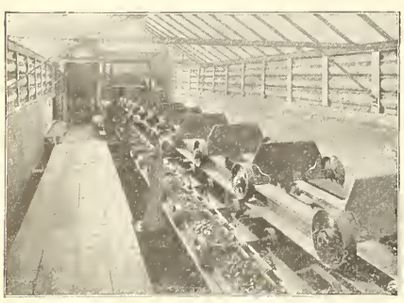
For reports of the Bureau of Mines, maps, mining laws, etc, apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

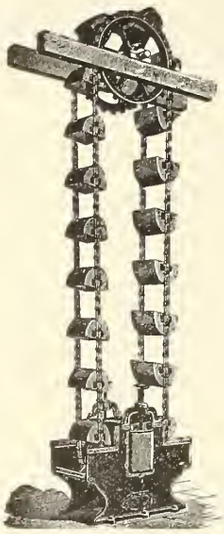
or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

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Freight and Package Elevator

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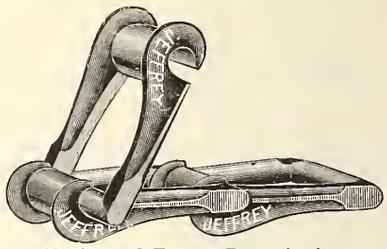


Endless Apron-Pan and Truck Conveyor



Elevator Buckets

Any size, shape or capacity.



Chains of Every Description

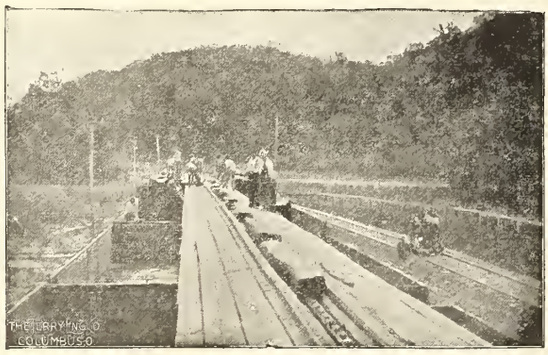
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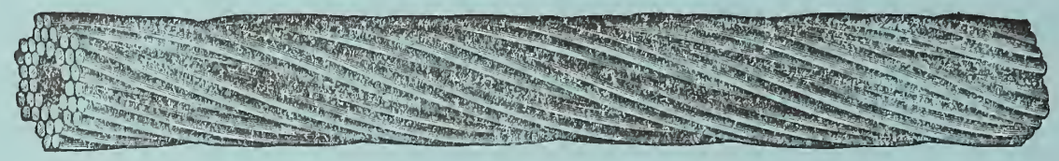
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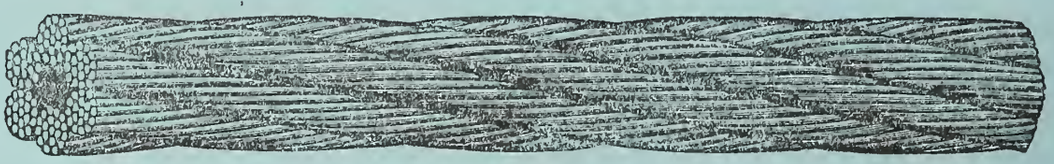
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FOR COLLIERY AND GENERAL MINING PURPOSES.

ALSO BEST STEEL WIRE ROPES FOR ALL PURPOSES.



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RELAYING RAILS 45 lbs., 56 lbs., 65 lbs. per Yard.

IMMEDIATE SHIPMENT.

LIGHT MINING RAILS

12 lbs., 25 lbs., 30 lbs., per Yard

..IN STOCK..

JAMES COOPER

ORE AND **..Mining Cars..**

WHEELBARROWS ALL KINDS

SPECIAL ORE BARROWS

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Established 1882

Vol. XXI—No. IV. OTTAWA, APRIL 30th, 1902. Vol. XXI—No. IV.

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Two Tanks in the Mine—
The Compressor and Switch in the Engine Room—No Floats.

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Stone Channelling Machines, Coal Mining Machines, and Complete Plants of Mining Tunnelling and Quarrying Machinery.

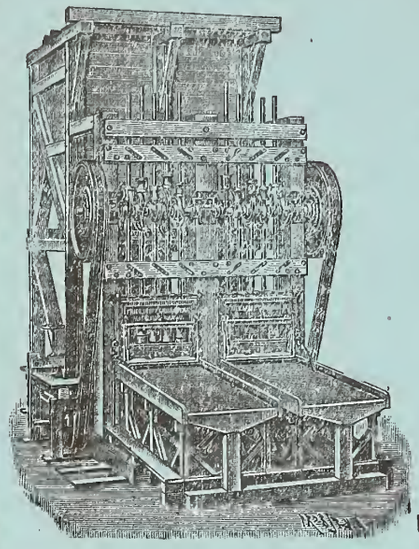
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Shoes and Dies of Krupp's Special Steel.

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Complete Gold Ore Dressing Plant

a. For treating by the Wet Method with Stamp Batteries, Amalgamation and Concentration.
b. For Dry Crushing by Ball Mills Dust Extraction, and Leaching.

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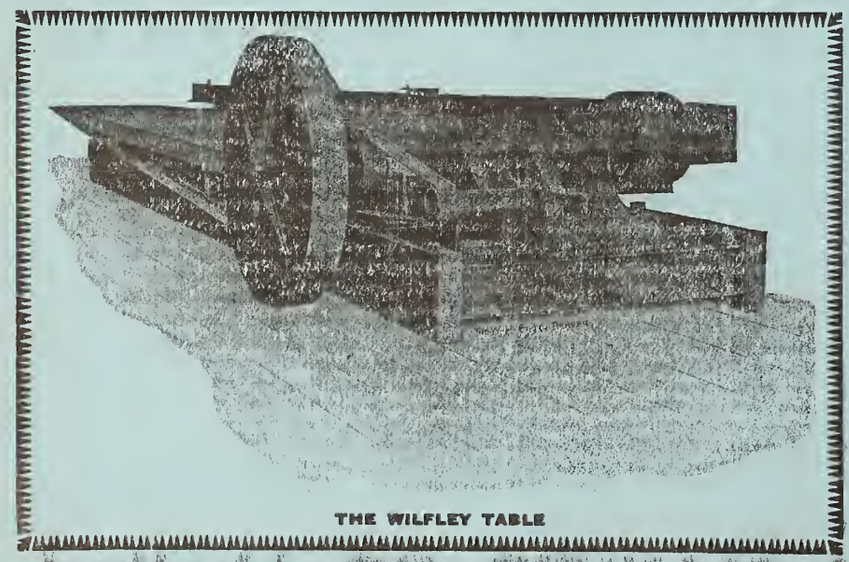
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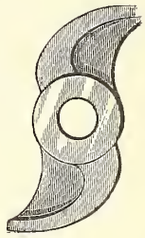
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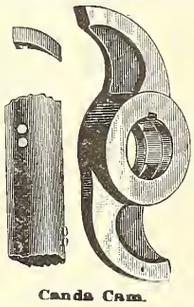
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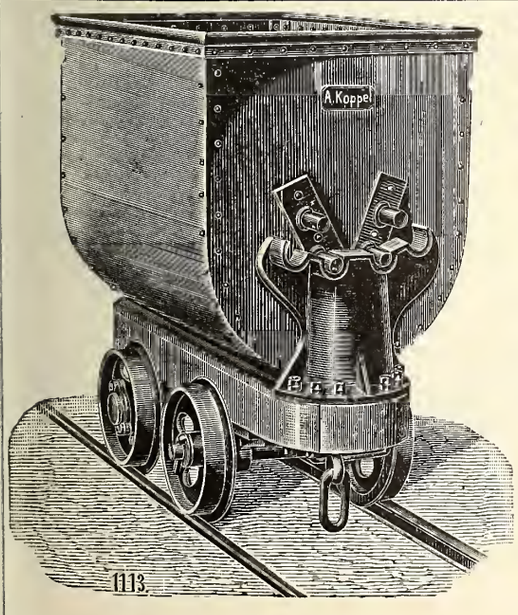
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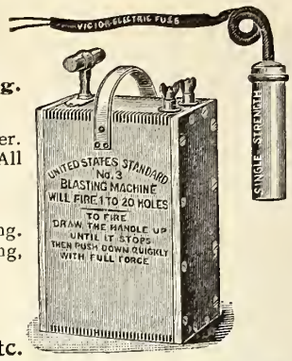
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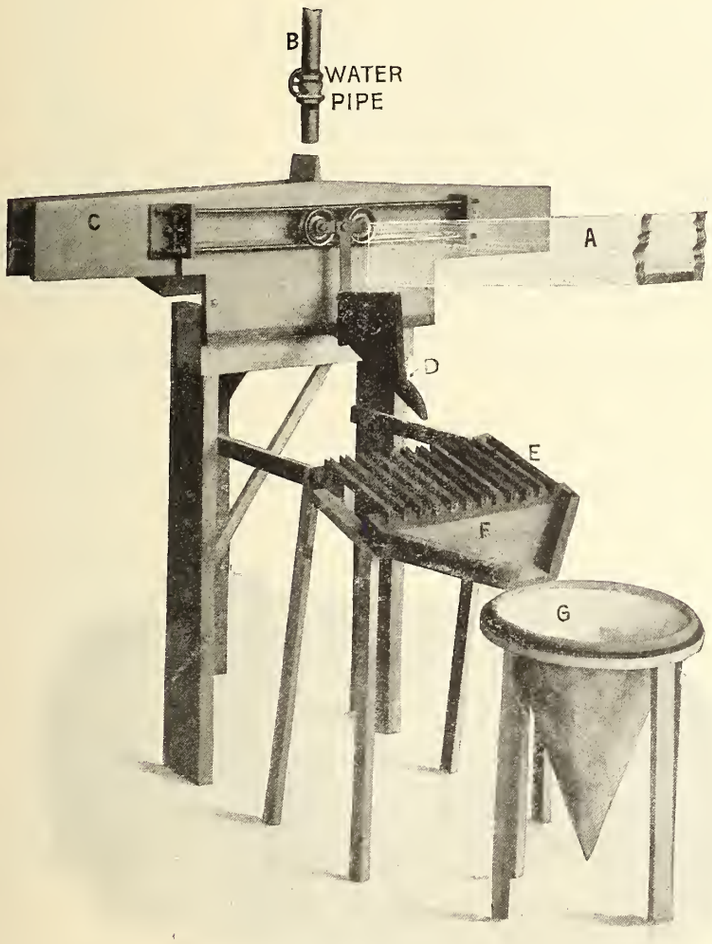
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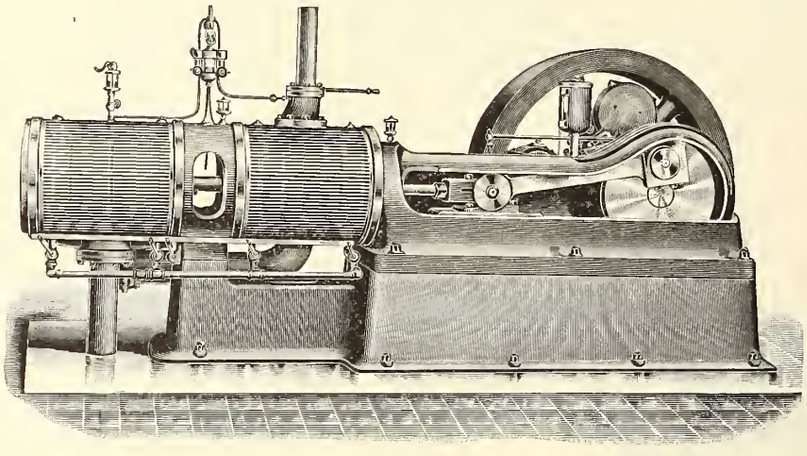
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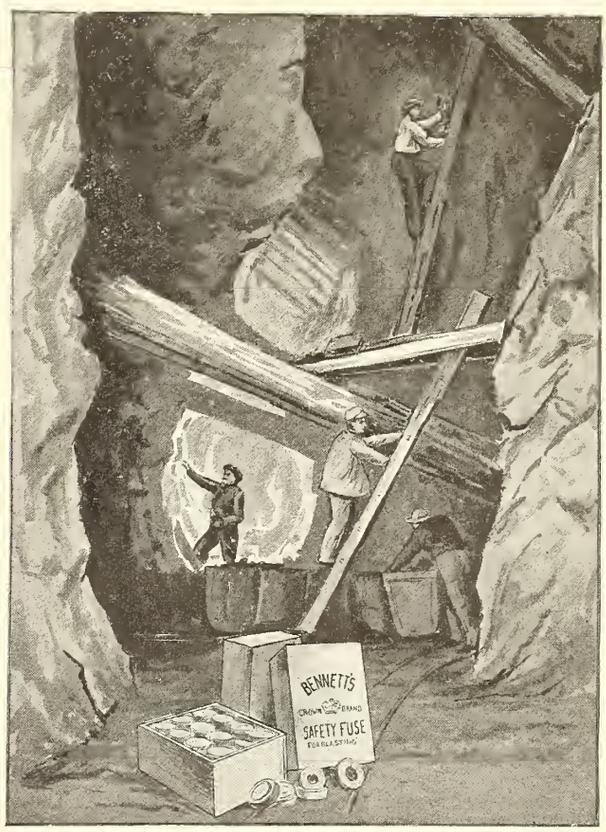
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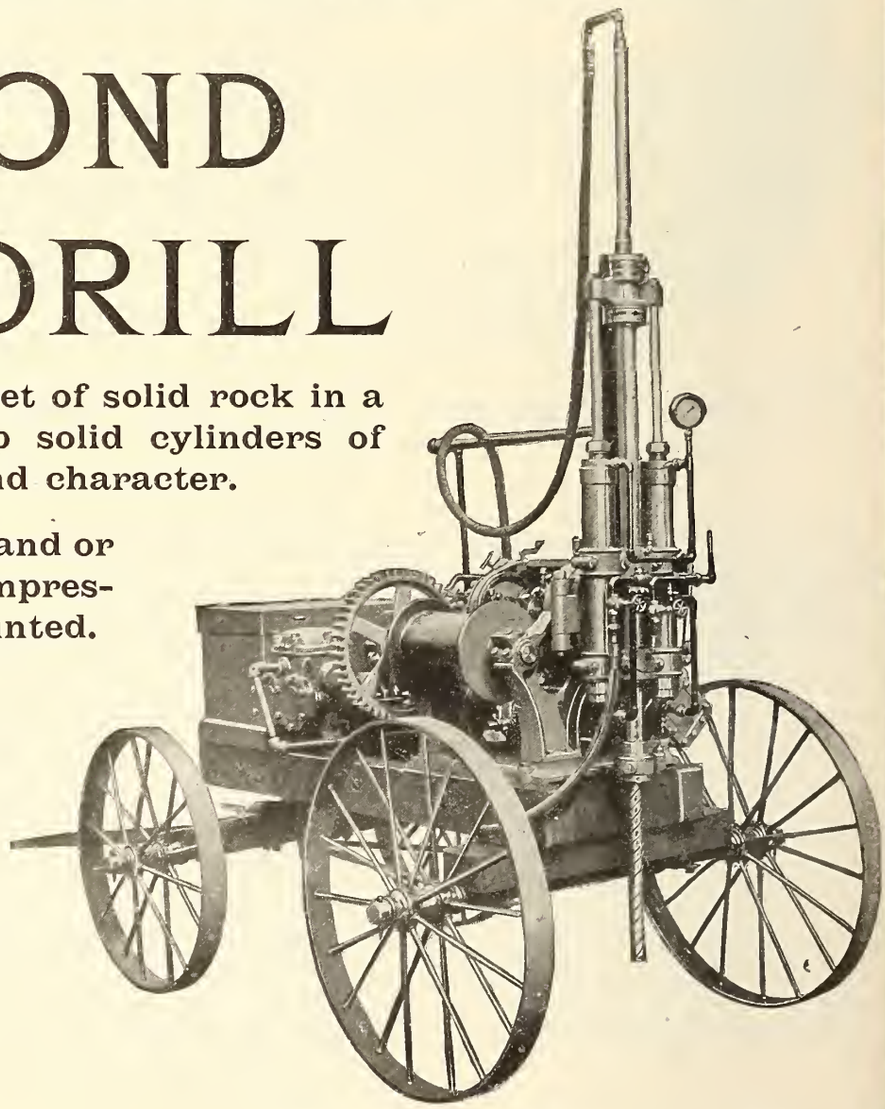
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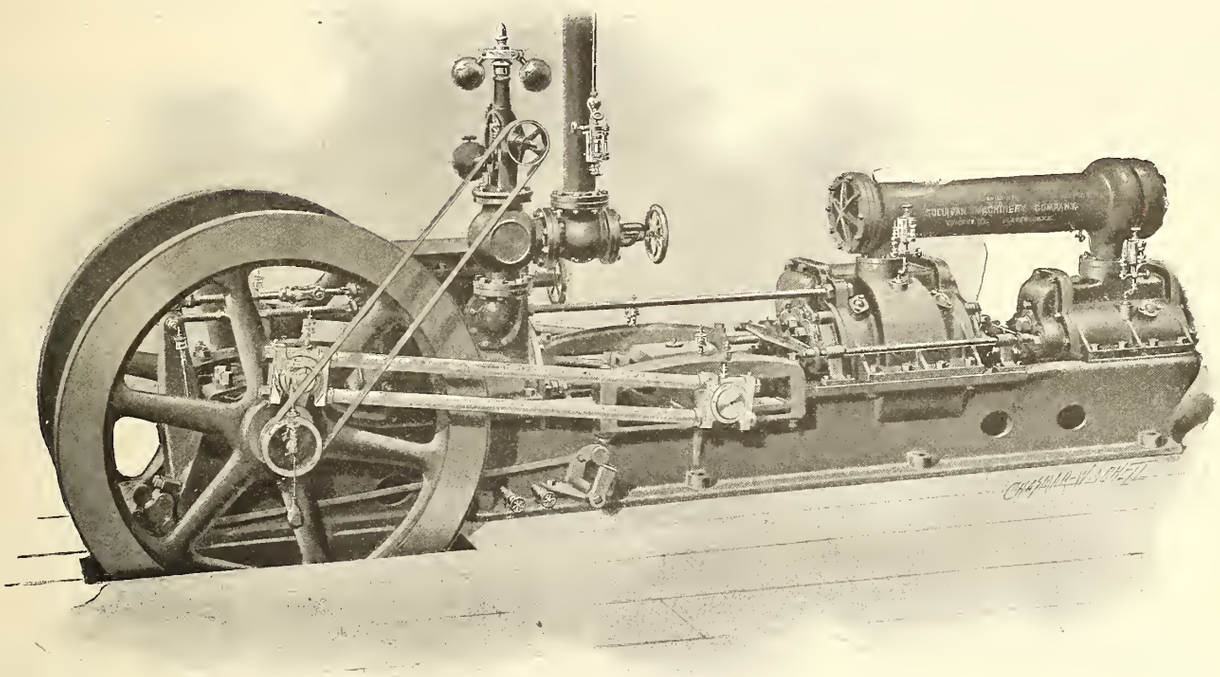
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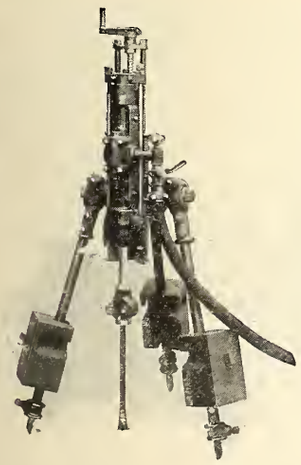
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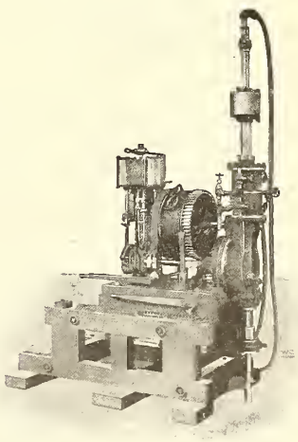


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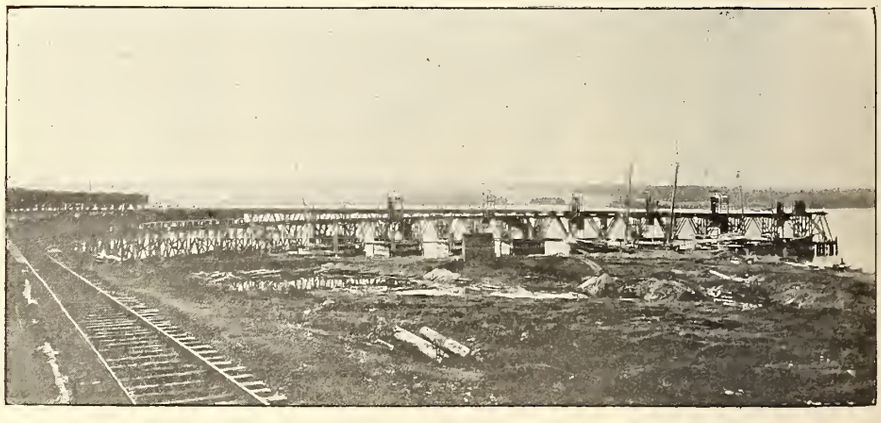
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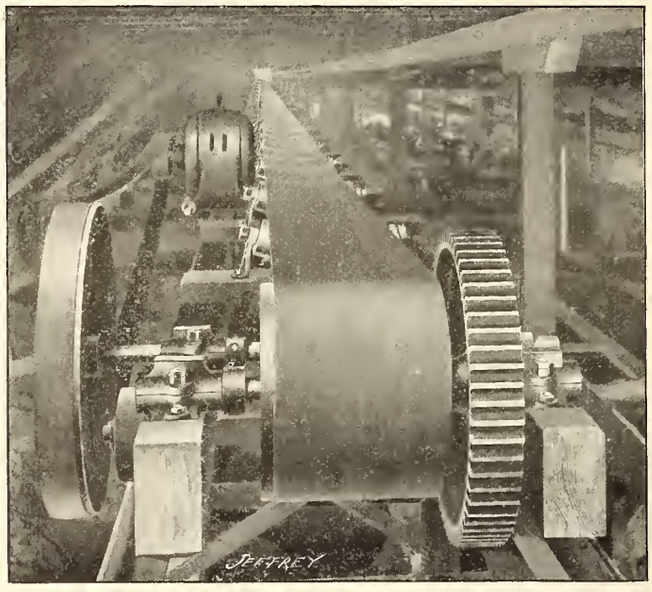
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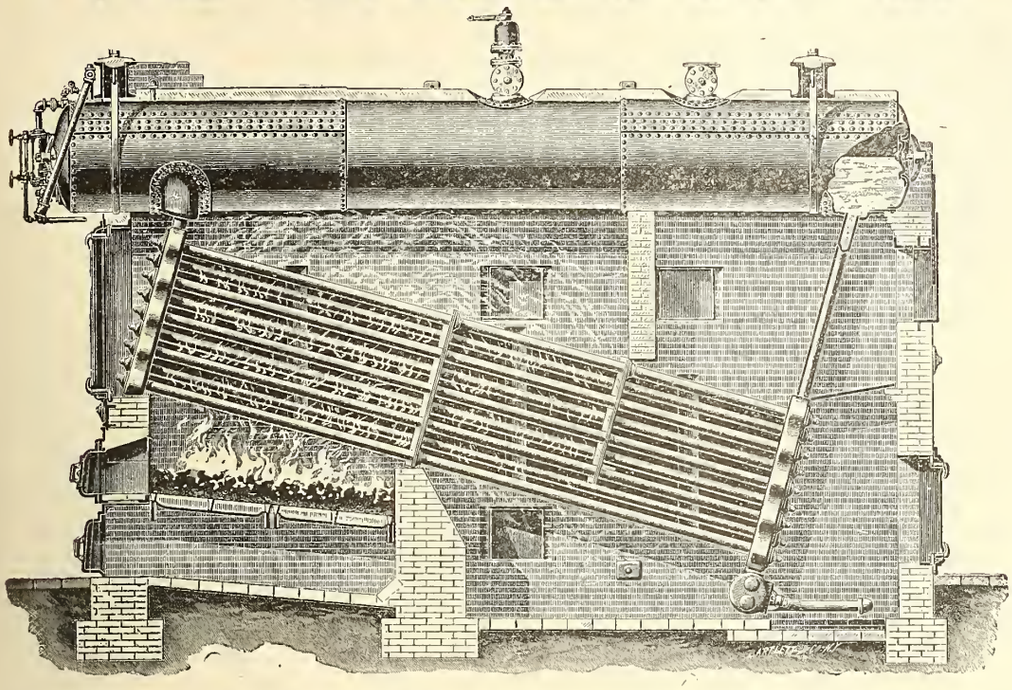
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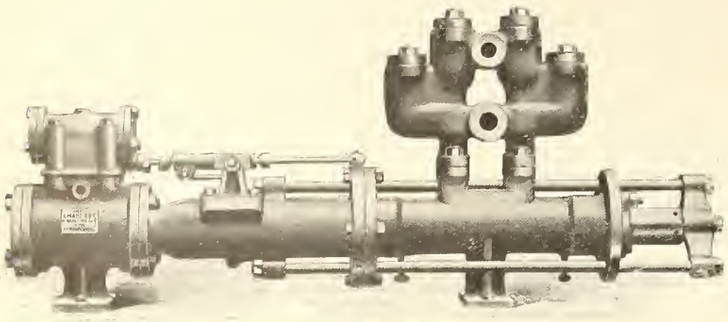
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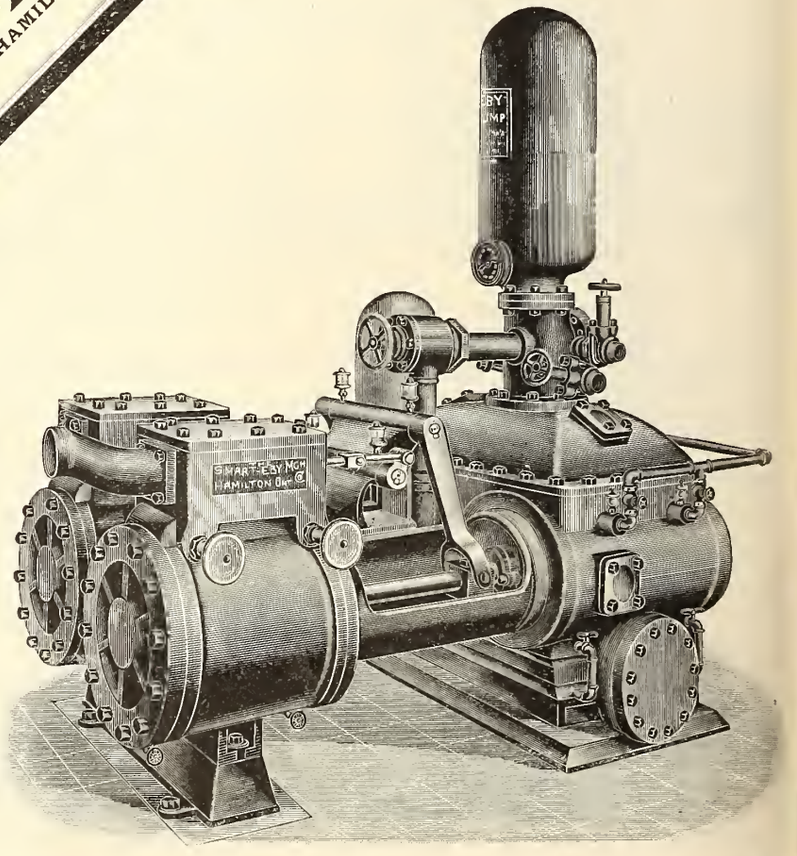


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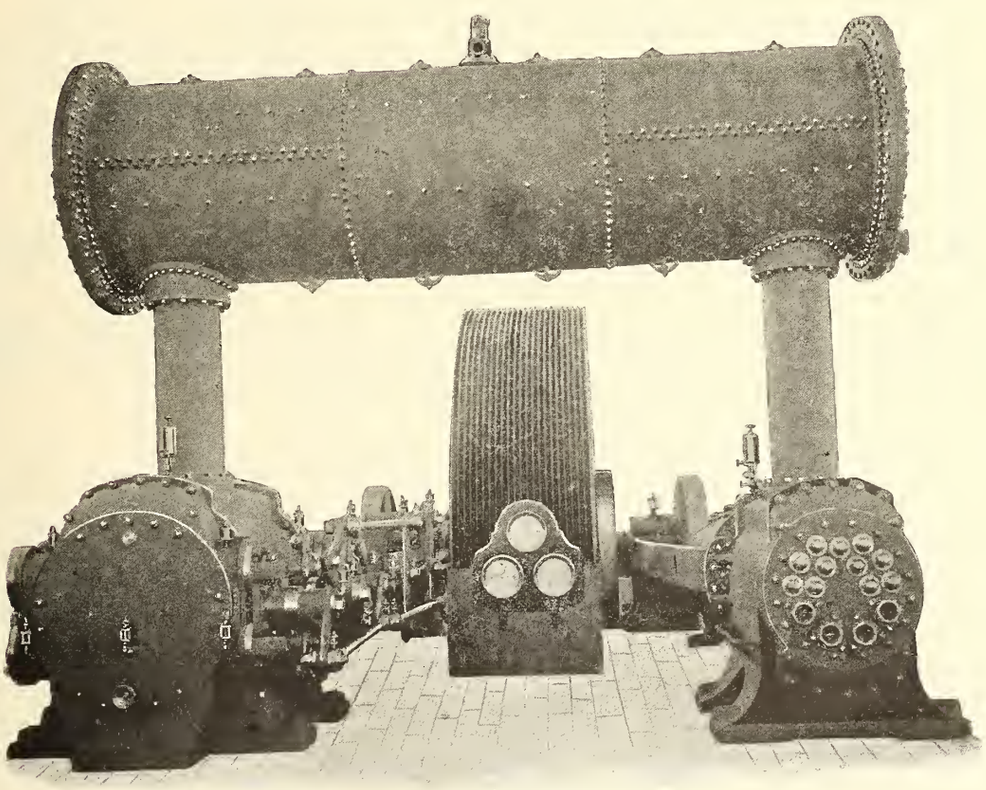
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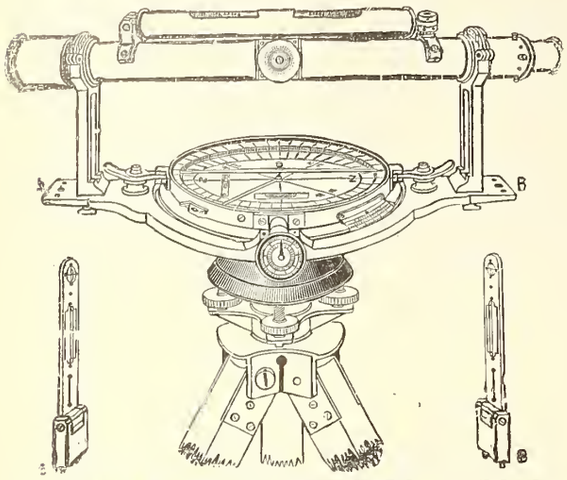
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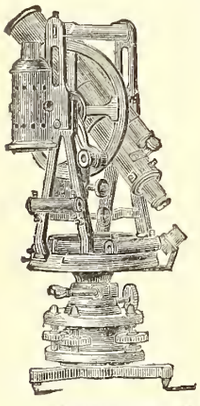
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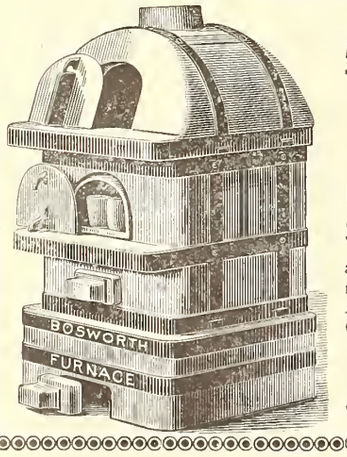
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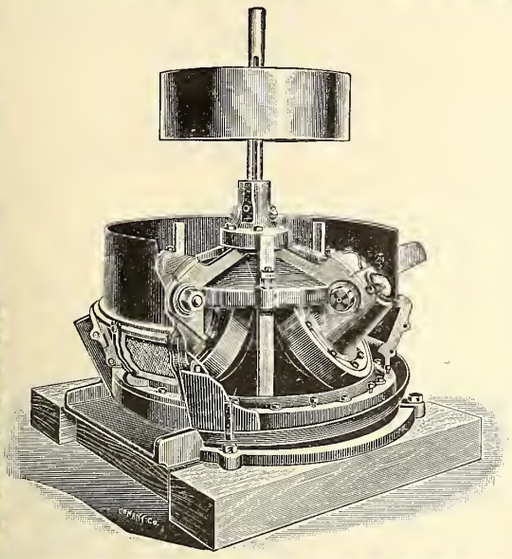
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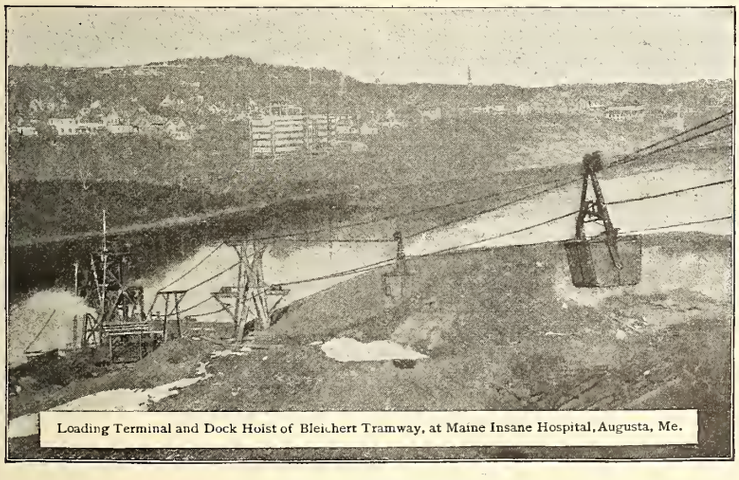
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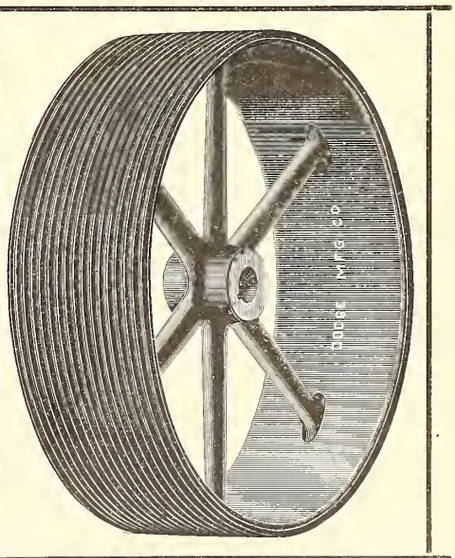
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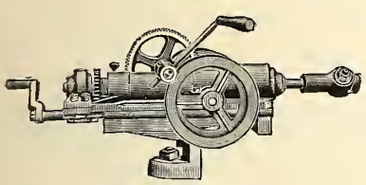
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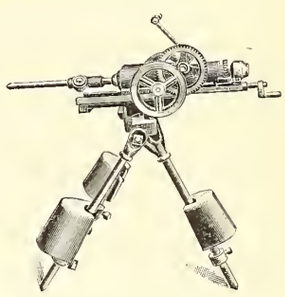
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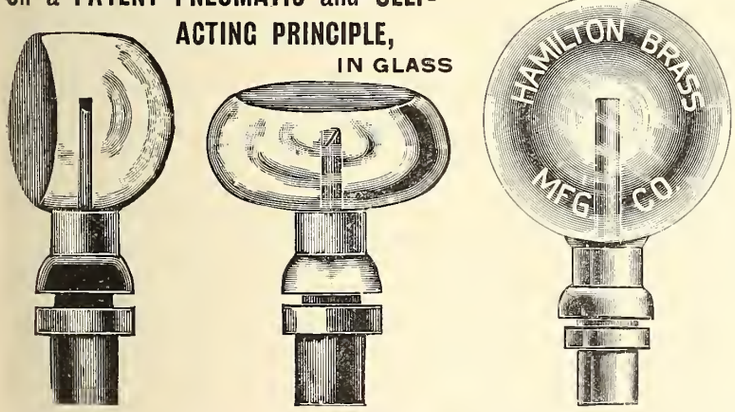


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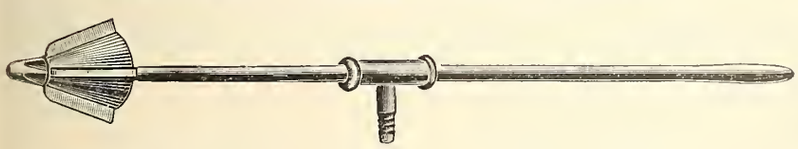
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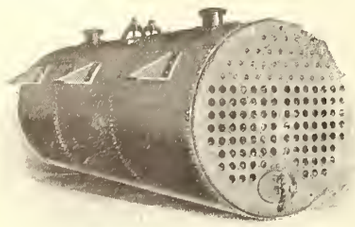
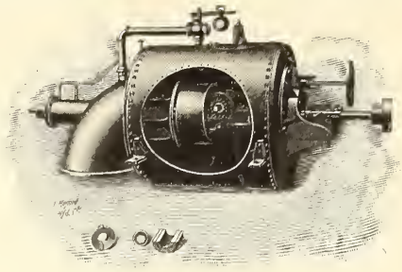
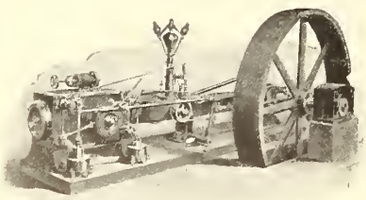
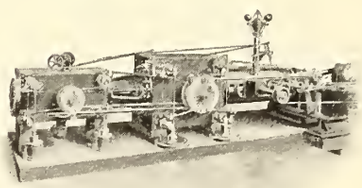
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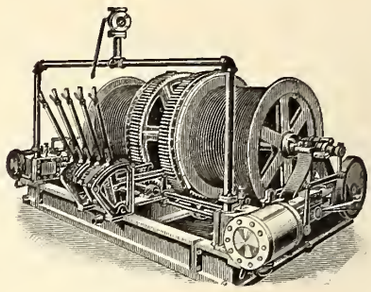
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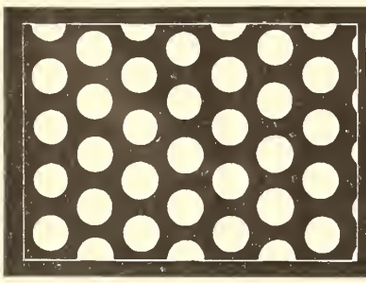
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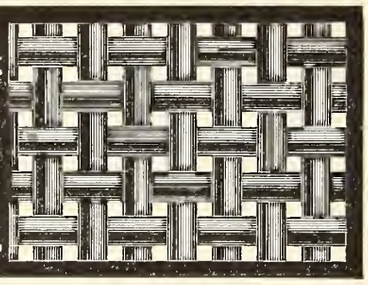
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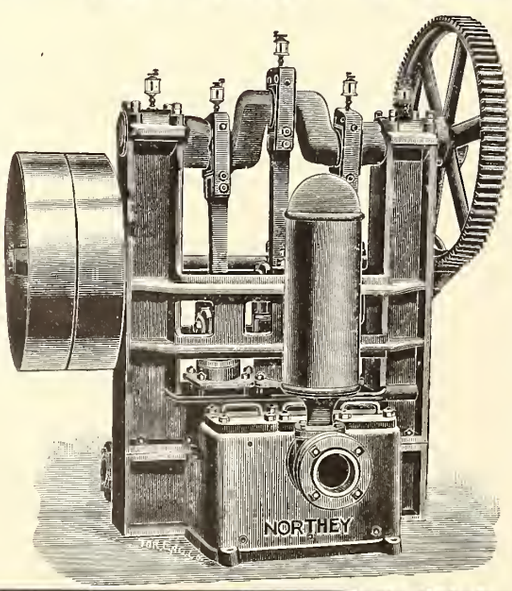
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The Future of the Dominion Coal Company.

The sensational advance in this stock from 33, at which it stood a year ago, to the high-water mark of 149 during the present month is probably without precedent in the history of industrials, and the extreme fluctuations which have taken place during that time are only matched by the extreme views taken by those who have tried to explain the cause. That much of the buying has been speculative, and that the public has rushed in and out a dozen times to scalp a few points is notoriously true, but no one acquainted either with the character of the property or with the methods of stock exchange manipulators will for a moment believe that the stock has been carried to the present high price by any such speculation. Other hypotheses have been put forward, any one of which may be true, as for instance that an amalgamation with the Steel Company would be effected on more favorable terms than the 6 per cent. interest originally specified. Or, again, that a still larger financial scheme was on foot through the agency of the Managing Director, which would effect the amalgamation of the two companies on the basis of a stock valuation. The third suggestion can only have been a mere guess, namely, the revival of the rumor of a year ago that a sale of both properties to the United States Steel Company was on the *tapis*.

We are not concerned either to confirm or deny any of these rumors, but for the information of our readers propose to discuss the intrinsic value of the stock on its own merits as a profit earner, our remarks being based upon actual data furnished to us by a competent expert, and our object to prevent a feeling of panic amongst those who may have bought stock at recent prices, should any of the imaginary schemes fail to be realized. Nothing would be more disastrous both to the individual investor and to the industries of the Maritime Provinces than that there should be any serious collapse in the price of Dominion Coal stock, and that this is not necessary, whatever may happen to outside schemes, is well known to those who have a thorough knowledge of the capacity of the concern.

Our conclusions are based upon an estimate as to the future profits of the concern, but we will anticipate the very natural question as to why such profits are expected in view of the fact that the company has been in operation for 9 years without paying any dividend on common stock. This must be explained before one can claim credence for favorable estimates of the future. Briefly then, the past history of this company may be summarized as follows:—

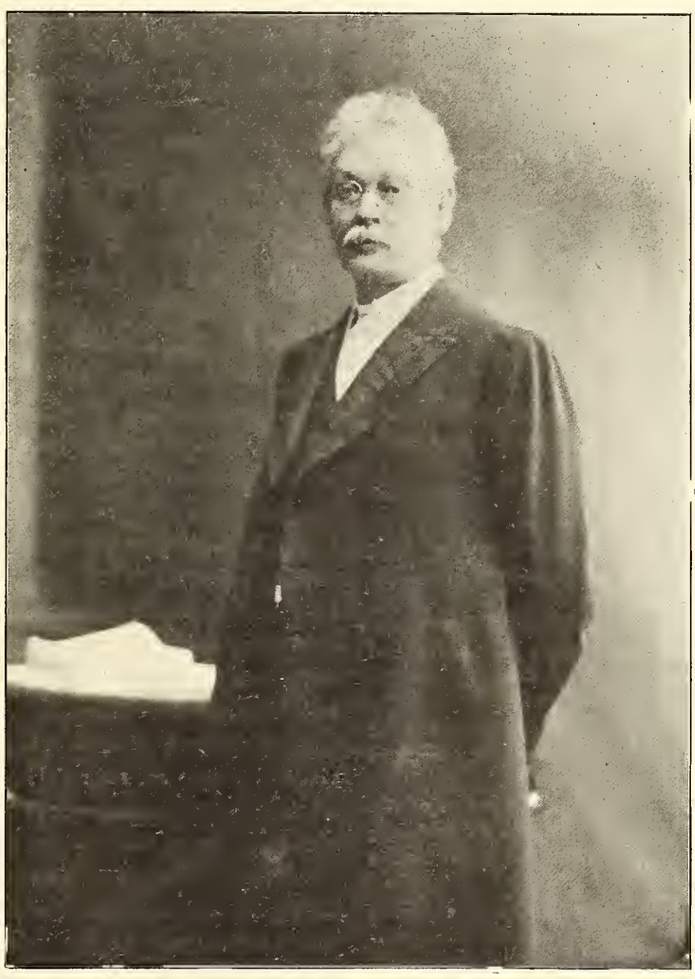
Acquiring in the fall of 1892 all the operating coal mines of the County of Cape Breton, except the Old Sydney Mine, they commenced seriously in 1893 to remodel and equip the mines, which they proposed to operate according to modern ideas. The history of the coal trade in Cape Breton for 30 years preceding this had been that of 6 to 8 months work and 4 to 6 months enforced idleness during the winter, with a very modest profit in favorable years, and no profit at all at other times; and in addition the cost of producing coal was extremely high in consequence of the antiquated methods of machinery employed. This is evidenced by the fact that in the first report issued by the new company they stated that the average cost of coal when the mines were taken over by them was $1.14 a ton; it was, in 1898, reduced to 80 cents. In addition to equipment a larger market was necessary, and especially a winter trade. To secure this Mr. Whitney made a desperate effort to carry free coal in the United States Senate, and it is a matter of history how at the last moment the measure was defeated. This was a source of great disappointment to the promoters, and for the moment seemed almost fatal, since they had expressed the utmost confidence in the passing of the measure, and had spent enormous sums of money in equipping their mines and building railways and piers on the strength of the possibility of the New England market, which consumes 8,000,000 tons of bituminous coal a year, and would undoubtedly have taken from the Dominion Coal Company as much as they could furnish. This then was the first great blow which the company received, disappointing them as to an outlet for a larger tonnage, and rendering useless much of the heavy expenditure which had been incurred. Whilst on this point of expenditure it is only fair to our statement of the case to say that a great mistake was made in placing men without any previous knowledge whatever of mining operations in charge of most of this expenditure. Men, who had distinguished themselves in other professions, such as electrical engineering, civil engineering, and street railway work, were imported to devise and superintend the equipment of coal mines, a policy which undoubtedly cost the company several million dollars, and is represented in Cape Breton to-day by numerous monuments of folly in the shape of heaps of scrap iron, and abandoned machinery and appliances. We do not hesitate to say that if the management had been conducted upon the same intelligent lines which have been adopted during the past year since the concern came under Canadian control, with a capable business man at the head of affairs, a practical mining engineer in full charge of mining operations, and an expert controlling each department, all with a free hand in their own section, the company would have been saved from an enormous expenditure upon useless appliances, and would have developed far greater capacity than has yet been reached. It has long been an

open secret that until the advent of the present management there was no executive head; officers in Boston, officers in Montreal and officers in Cape Breton were working at cross purposes, questioning each other's authority, undermining each other's influence, and frittering away one of the finest properties on this continent, until when it was taken over by Mr. Ross and his associates it was practically on the verge of bankruptcy. To illustrate this point we cannot do better than refer to the ridiculous and ill-advised opening of the Emery seam, which was insisted upon two years ago by an official who should have had no influence whatever in the mining department, but whose favorite hobby it had been for at least 7 years to develop this seam. The experts were unanimous in their opinion that the coal could not be profitably worked, and in support of their contention pointed to the fact that nearly $100,000 were spent between 1890 and 1893 in endeavoring to work it near the Reserve mine, and after a thorough proof and a heavy loss it was abandoned. The result of the latter experiment, which has just had so ignominious a conclusion, was the further expenditure of more than $250,000, and the abandonment of the operations after an expensive modern plant had been erected, and every preparation made for doing a large trade. Equally fatuous was the policy of the same official in bringing about the closing of the Victoria mine in 1896; a mine which contained the best quality of coal on the company's areas, and the only quality which would compare with that produced by the Old Sydney mines. True, this coal was costing 20 cents a ton more to mine than the average of the other coals produced by the company, but it easily sold for 25 cents a ton more, and will have to be re-opened if the company wish to compete with the Nova Scotia Steel and Coal Company for domestic trade. A third blunder, worse than either of the foregoing, was committed in 1896, on the advice of an official who had no possible connection with the mining department, in the closing down of the Stirling mine. This mine operated in the Harbour seam, and had been splendidly equipped during the two preceding years at a cost exceeding $200,000; in fact the old plant had been torn out and replaced by the most modern appliances, and a successful system of haulage and coal cutting by machinery established. At the time the mine was closed it was producing coal cheaper than any other mine belonging to the company, all the same it was shut down and dismantled almost before the mortar was dry in the new buildings. The most remarkable feature of the case, however, is that the company continued to operate upon the same seam, an old ill-equipped mine, the International, which has been a source of trouble ever since, has been partially flooded for the last 4 years, and is still working at a much heavier cost than would have been necessary at the Stirling mine. Such gross stupidity can only be explained on the ground of utter ignorance and incompetency, and we have referred to it simply to confirm our statement as to the kind of management which is responsible for the position in which this company found itself in the spring of 1901. Passing from the blunders made in Cape Breton, we come to what has so far proved the most suicidal policy upon which the company has ever embarked. When the measure for wiping out the duty on coal imported into the States was killed, the energetic president began to look around for some other means of establishing a market, and with great energy and skill in the face of tremendous odds succeeded in establishing the New England Gas and Coke Company. It is a secret, but not an open secret in spite of the lucubrations of Mr. Thomas Lawson, what this measure cost, but it must have been something considerable. So far the policy was an enlightened and commendable one, but in the light of recent events it was manifestly the greatest mistake which could have possibly been made, both for the Coal Company and the New England Gas and Coke Company. The former were tied to a contract compelling them to furnish a tonnage of coal which at that time was equal to almost the whole of their output, and which may be stated as a maximum of 1,000,000 tons a year, at a price which left absolutely no margin of profit. There have been numerous contradictions as to what this price actually is, since it is a moveable one, but at the present time it may be stated at $1.50 a ton; it has been as low as $1.05. The only effect of this contract so far has been to deprive the company of the opportunity to sell from 600,000 to 800,000 tons of coal in the open market at prices ranging from $2.50 to $3.50 a ton, and the best authorities have estimated the actual loss, being the difference between cost and selling price, as involving the company in a loss of $250,000 last financial year. The most singular aspect of the matter is that even upon such a low contract the New England Gas and Coke Company have not been able to manufacture their product at a profit, but are at the present moment in liquidation, having lost every cent of the common stock invested in the company, and being dependent upon the good will of the bondholders if the concern is to be reconstructed. In view of these facts it is hard to see at what price the Gas Company could import Dominion coal and manufacture their goods at a profit; it looks as if they would have to beg it. Undoubtedly this was the last straw that broke the camel's back, loaded up the Dominion Coal Company with nearly $2,000,000 of a floating debt, and kept their common stock wavering between 10 and 25. Now all this is changed, we find common stock at 149 with plenty of eager buyers, and everyone connected with the concern jubilant as to the future. How far is this state of mind justifiable? We will endeavor to answer the question, and the first reasonable ground of expectation is based upon the fact that totally inadequate management has been replaced by a well organized and systematic staff, with admittedly one of the strongest and most brilliant of Canadian financiers at the head. Under this new control, in the short space of one year, the capacity of the mines has been increased at least 25 per cent., in spite of the legacy of blunders which they had to shoulder. The directors have for the first time realized the impossibility of doing any considerable trade with the United States so long as their high tariff wall exists, and have boldly gone out over the seas to establish a new market. The result of this enterprise is already known. The coal has been successfully placed in some of the best European markets, and it is now not a question of seeking a market but of producing sufficient coal to supply at remunerative rates. The West Indian and South American markets have not yet been touched, but we are satisfied in the course of a few years it will be demonstrated that there are possibilities in that direction.

We have said nothing hitherto about the great twin enterprise the Dominion Steel Company, because we intend to deal with that in a future article, but it furnishes one of the most important factors in considering the coal company because of the permanent market which it affords for a large tonnage, and it would be unfair not to admit that Mr. Whitney is entitled to the highest praise for his conception and successful launching of this great enterprise; it is the true solution of the difficulty as to a permanent market. Summarizing our conclusions we consider that during the financial year ending February 1903 the profits of the company should be $2,600,000, based upon the sale of

1,000,000 tons to the Steel Company at a profit of 50 cents a ton	$ 500,000
1,400,000 tons in the open market at a profit of $1.50 a ton	2,100,000
	$2,600,000

This assumes the sale of 600,000 tons to the New England Gas and Coke Company in the event of their continuing to do business



DR. EUGENE HAANEL, SUPT. OF MINES, OTTAWA

Dr. Haanel will, in every likelihood, be the Director of the new Department of Mines and Geology, at present being organised by the Hon. Clifford Sifton, M. P., Minister of the Interior.

upon which no profit will be made, but it will probably be produced at cost. If, however, the coal should not be shipped to that concern it could be classed with the sales in open market, and would show a further profit of $900,000. These estimates of profit do not include interest upon bonds.

From this it will be seen that the balance of the floating debt which is in the neighborhood of $800,000 could be paid off, and a handsome dividend also paid upon common stock. It also shows that when once the floating debt is got rid of there should be a substantial dividend even upon a consolidated capital account of $20,000,000 which has recently been talked about.

This estimate is based upon the earning power of the coal as an independent going concern. In view of what has been demonstrated during the past year as to the possibilities of coal, we do not believe that the Steel Company, even if disposed, can exercise their option on the basis of 6 per cent. interest. Should it be found necessary to amalgamate upon an interest guarantee, we hold that it should certainly not be less than 10 per cent, and would remind our readers that in the earlier days of the concern there was an issue of perference stock bearing as much as 12½ per cent.

Since the above went to press the following statement has been made public by Mr. James Ross, Managing Director, concerning the amalgamation of both companies :—

"1. The Steel Company agree to pay the fixed charges of the Coal Company, that is, the interest on its 6 per cent. bonds, the dividend on its 8 per cent. preferred stock and the sinking fund of 5c per ton on the entire output to provide for the redemption of the bonds and preferred stock

"2. A 6 per cent. dividend on the common stock.

"3. An allowance of $25,000.00 a year for the Coal Company's expenses, the latter company having to maintain a staff to look after its property, and for accountancy work, etc, etc.

"4. The Steel Company to pay to the Coal Company $600,000 in cash as a forfeit for the due carrying out of the terms of the lease.

"5. The Steel Company to pay to the Coal Company a royalty of 15c per ton on every ton of coal taken out of the property in excess of 3,500,000 tons in any one year.

"6. The Steel Company to assume and pay all the debts and liabilities of the Coal Company, less the value of certain cash assets, which the Coal Company was to retain. The obligation of the Steel Company in this respect involves an immediate payment of about $2.000,000.00.

"7. The property to be leased did not include all the properties of the Coal Company, certain valuable properties, including shops and the entire mercantile business of the Coal Company, being excepted."

The Directors, in considering what modifications of the terms of the option might be made, so as to make an arrangement that would be entirely satisfactory to both companies, and ensure harmony between them, had to consider the following points :

1st—The Coal Company had earned during the past two or three years $1,530,000 in excess of all its fixed charges, but none of this had been distributed amongst its common stockholders by way of dividend, and it was admitted by all concerned that the stockholders were entitled to this surplus in the event of the option being exercised by the Steel Company.

2nd—The ability of the Steel Company to raise the $600,000 and the other sums required to discharge the debts and obligations of the Coal Company, which, as above mentioned, would amount to about $2,000,000 more.

3rd—The disruption of the business now carried on by the Coal Company, if but part of its properties and assets were taken over, leaving still in the hands of the Coal Company valuable assets, including its mercantile business.

After careful consideration, it was unanimously resolved by both boards that, subject to ratification by the shareholders of each company, an agreement should be entered into embodying the following terms :

(*a*) "The present agreement to be modified so as to make it include all the properties and assets of the Coal Company, including the $1,530,000 surplus earnings above referred to.

(*b*) "The Coal Company to pay off its bonds and preferred stock by the issue of $5,000,000 common stock at 120 to its common shareholders thereby increasing its total capital to $20,000,000.

(*c*) "The Steel Company to be relieved from the obligation to provide the $600,000 forfeit money, and to pay the Coal Company a rental equal to 8 per cent. on its $20,000,000 capital stock."

The New Superintendent of Mines.

At the moment when the Dominion Government has under consideration the reorganization of the Geological and Natural History Survey of Canada and its consolidation with the new Department of Mines and Geology, the portrait of Dr. Haanel, who will, in all likelihood, be the head of this important institution, will, we are sure, be of interest to our readers.

For some time past Dr. Haanel has occupied the position of Superintendent of Mines to the Federal Government at Ottawa, his first work being the designing and equipment of the excellently organized Government Assay Office at Vancouver. This office has a capacity of handling $500,000 per day, and it is equipped and managed so excellently that it is possible to give the value of the dust to the miner within 24 hours of its presentation at the office, and in few cases does the delay extend over 48 hours. As an encouragement to miners to have their gold assayed at this office, the Government has passed a regulation by which miners who personally deliver their gold at the office are refunded one per cent. on the net value of the gold upon which they have paid royalty, so that in the case of such miners the Yukon royalty is reduced to only four per cent. This concession will no doubt act as an incentive to miners to patronize the institution. Up to 1st January last the office treated 465 deposits, representing 57,221 ounces of gold of a value of $939,654.41.

In addition to the work of supervision of the mining territory of the Yukon and North-West Territories controlled by the Federal Government, and the preparation of statistics and other work of his department, Dr. Haanel is busily engaged in designing and laying out plans for the handsome National Museum which will, we hope, before very long, adorn the public buildings of the capital.

Although only a short time with us, Dr. Haanel has created an excellent impression among the mining men with whom he has been brought into contact. He strikes us as a shrewd, broad-minded officer, fully alive to the importance and necessities of our rapidly expanding mining industries. He possesses an excellent technical training for his work, and, we should judge, will make an excellent administrator of the new Department of Mines.

Dr. Eugene Haanel was born in Breslau, the capital of Silesia, Germany, May 24, 1841. His parents were at the time people of wealth, his father being a lawyer of considerable repute, having charge of landed estates in and about the city of Breslau.

The earlier days of his youth were spent in Breslau. He passed his school days there and graduated from the gymnasium in a classical collegiate course in 1858. At the age of 17 an irresistible longing to visit foreign lands led the young man to America and for about a year his adventures as a wanderer through the Southern States were of a most romantic kind.

After a year's visit to his parents and his native city he returned to America to live. The War of the Rebellion soon broke out and Dr. Haanel enlisted in the Union Army as an hospital steward. He served in this capacity for three years and was then appointed first lieutenant of the Second Maryland Volunteers, where he served until the end of the war, participating in many of the principal engagements.

Not long after the close of the war Prof. Haanel was elected to the professorship of modern languages in Adrian College, at Adrian, Michigan. He served in this position for one year and then went to Hillsdale College, where he taught the modern languages and philosophy.

In 1867 Professor Haanel was elected professor of natural sciences in Albion College, a Methodist institution, in Albion, Mich. During his work at this institution, which lasted four years, he worked labor-

FOR KING AND EMPIRE.



LIEUTENANT BRUCE CARRUTHERS, KINGSTON, ONT.

A member of The Canadian Mining Institute who greatly distinguished himself last month in action at Hart's River, South Africa.

The following is excerpted from the despatch to the *Standard* describing the gallant stand made by Lieutenant Carruthers and his brave Canadians:—

In the meanwhile, the small band of Canadians and mounted infantry on the other flank found themselves opposed to a force seven times their own number. About 600 Boers advanced upon them, under cover of the belt of trees, and charged down upon the thin line, calling upon them confidently to surrender.

Lieutenant Carruthers, of the Canadians, promptly sprang to his feet, and crying "Back! no surrender!" shot down the foremost man with his revolver, at a distance of 15 paces. The men were not slow in emulating their gallant leader. There was absolutely no cover for them, except the short grass, but lying down in it at full length, they fired steadily and straight, and forced the Boers to bolt back to the screen of trees. The enemy, however, were determined to capture or annihilate the little band. While some of them climbed into the trees, and, from that position of advantage, fired down on to our men, the others extended their line, and quickly brought the defenders under a decimating cross fire.

But every man of the seventy proved himself a hero. For two hours, until all but 15 of their number had been killed or wounded, they kept the 600 Boers at bay. It was not till then that the enemy ventured to make another rush, and succeeded in capturing the handful of survivors. The Canadians had 21 men out of the 24 killed and wounded, and the mounted infantry lost 30 out of 45. Lieutenant Carruthers was the only officer who was not either slain or seriously hurt. He had several flesh wounds, and his clothes were perforated in many places by bullets, but he stoutly refused to go to hospital. When he was taken prisoner, some of the Boers wanted to shoot him there and then; but they ultimately thought better of it, saying that he was "too brave a man to die in that way."

iously for the department of which he was the head, with the result that it became the largest and one of the finest equipped in the institution. While at Albion he received the degree of Master of Arts from Ohio University.

At the end of his fourth year at Albion, Prof. Haanel's health was so seriously broken down from overwork that he made a second visit to his parents in Breslau. He soon recuperated in his native air and within a year graduated with honor as Doctor of Philosophy from Breslau University. His inaugural dissertation, chosen from only a slightly investigated field and entitled "A Galvanometric Method for the Determination of the Earth's Magnetism and Its Oscillations," gave him at once a high standing among scientific men.

Without loss of time Dr. Haanel returned to America and joined the staff of Victoria University, Cobourg, Ont., where he was for fourteen years the dean of the department of Science and director of Faraday Hall. Many men who were his pupils during these days have since become prominent in Canadian affairs.

Dr. Haanel then went to Syracuse University in 1888, upon the removal of Victoria University to Toronto. He was at the time offered a chair in Toronto University at a much larger salary than he was to receive in Syracuse, but he realized that there were great possibilities in the department of physics in Syracuse University and chose the position there.

When he took charge of the department of physics it was inadequately equipped, but under his supervision and through the generosity of friends of the University, apparatus and equipments have been added so that the department is considered to be superior to that of almost any other institution of the size in the country. Students have been taught the manufacture of apparatus and much of the valuable equipment has been made by their labor.

The regard with which Dr. Haanel was held in Victoria University is illustrated by an incident which occurred soon after his departure from that institution and shows no greater esteem than his students in Syracuse University held for him. The year after his departure from Victoria he returned to Toronto in order to give examinations in some of the science work. Faculty and students met him in a body at the train when he arrived. He was taken to the University in a carriage surrounded by several hundred students acting as an escort.

Reported Nickel Consolidation.

The International Nickel Company, which was organized recently in New Jersey, is the result of the plans to consolidate and control the nickel production of the world, to which reference has been made in our columns heretofore. The plan was originated by Col. Robert M. Thompson, president of the Orford Copper Company, and has been carried through chiefly by his efforts, though he has had recently the aid of Mr. Schwab, of the United States Steel Corporation, and Col. J. R. De La Mar. The purchase of the stock of the Nickel Corporation, Limited, from its London owners was one of the steps toward the present consolidation.

The International Nickel Company will issue $12,000,000 in common stock; $12,000,000 in preferred stock carrying 6 per cent. dividends, non-cumulative, and $10,000,000 in 5 per cent. bonds having 30 years to run. Of the authorized capital stock $9,000,000 common and $9,000,000 preferred will be issued at once to acquire the properties named below. The remaining stock will be reserved for future use.

The officers of the company are announced as follows: President, Ambrose Monnell, formerly assistant to the president of the Carnegie Steel Company; chairman of the board, Col. R. M. Thompson, of the Orford Copper Company; general counsel, Max Pam, of the United States Steel Corporation; treasurer, Stephen H. P. Bell; secretary, Joseph Claudet. The list of directors includes, besides those named above, E. C. Converse, of the United States Steel Corporation; Joseph Wharton, of Philadelphia; Dr. Leslie D. Ward, Archibald W. Maconochie, Col. J. R. De La Mar; Millard Hunsiker, of London.

The properties in which the new company will own a controlling interest—if not the whole—are those of the Canadian Copper Company in Canada and the United States; the Orford Copper Company, with extensive reduction works at Bayonne, N.J.; the Anglo-American Iron Company and the Vermillion Manufacturing Company in Ontario; the American Nickel Works of Joseph Wharton in Camden, N.J.; the Nickel Corporation, Limited, and the Société Miniere Caledonienne in New Caledonia,

The Société Le Nickel, with its extensive properties in New Caledonia and its reduction works in France, is not included in the combination. It is intimated, however, that the International Nickel Company has already a full understanding with the French company. It is believed that a community-of-interest plan has been arranged which will regulate production, prices and a division of the markets.

The nickel companies not in the combine include the Mond Nickel Company, which has good properties in the Sudbury District, Ontario, and refining works in England; the Mond process, however, has not yet proved itself to be as great a success as its projectors expected, and its actual output has not been large. The same may be said of the Lake Superior Power Company, under the direction of Mr. F. H. Clergue, which has properties in the Sudbury District and proposes to refine nickel at the Sault Ste. Marie works. The Nickel-Copper Company of Ontario, which was organized to work mines at Sudbury and to refine the metal by the Frasch process, is doing nothing at present. In Germany the firm of Basse & Selve produces some nickel from Norway and New Caledonia ores and occasionally from Canadian matte, and there are one or two other refineries in Germany. The new International Company and the Société Le Nickel, however, will control by far the greater part of the world's production of nickel. The International Company will also have a considerable output of copper from its Canadian ores. We may add that there are believed to be some valuable nickel areas in the Sudbury District in Ontario which have not yet been taken up and are open to lease or location.

The extended use of nickel in steel making explains the interest in the new company which is evidently taken by the United States Steel Corporation; though there is no official connection between the two companies. Under date of April 14th, the *Cleveland Leader* supplements this information with some particulars concerning the sale of the Canadian Copper Company. It says:—

"Without owning a dollar's worth of the stock, Judge Stevenson Burke of Cleveland remains president of the Canadian Copper Company, which was sold to the syndicate headed by Robert M. Thompson, of New York, over a week ago. The transfers of stock were completed, and the company became the property of Mr. Thompson and his associates week before last.

There has probably never been another instance of such a remarkable confidence in the history of financial transactions. There is probably not another immense company that is left in the hands of a president who has sold every dollar of his interest in it, and it affords one of the most remarkable instances of confidence the business world ever saw. The figure at which the shares of the Cleveland stockholders was bought, $175, shows the value of the company to be over four million dollars, the capitalization having been two and one-half millions.

H. P. McIntosh, secretary treasurer, and general manager of the company, still remains the executive official of the company, although he, like the rest of the larger Cleveland shareholders, has sold his stock. The sale of an immense company like this is usually followed immediately by the election of new directors and officers, who represent the purchasers, but the Thompson syndicate seems satisfied to leave its enormous purchase in the hands of the former owners. No announcements have been made that indicate an immediate election of directors or officers to succeed Judge Burke

and the other officers and directors who have sold out their stock in the company, and they continue in control. Nearly all the Clevelanders who had stock in the company have sold out, the price paid for all the stock being about $175, or $75 premium. The stock has never been on the market, and was held altogether as an investment, so that it can only be assumed that the price paid by the Thompson syndicate was a good one, or it would not have been sold.

This syndicate is said to have also bought the great English company that practically controls the nickel business of Great Britain. This leaves the Thompson syndicate and Le Nickel, the great French company, owned by the Rothschilds, in control of the nickel business of the world. The Canadian Copper Company was, despite its name, much less important in the copper business than in the nickel business The ore it took from its Canadian mines bore about equal parts of copper and nickel, but the nickel was of much the greater value. It spent hundreds of thousands of dollars at an experimental works in the Cuyahoga valley in the southeastern part of Cleveland, developing processes for refining the output of its mines, separating the product into pure copper and pure nickel, and the process was just being perfected when the company was sold to the Thompson syndicate."

The Production of Copper in the Boundary District, B.C.

By Dr. Albert R. Ledoux, New York.

While the general public receives its impression of mining as an industry from reports of rich strikes and phenomenal yields, it is probably safe to assert that the industry itself depends upon the low grade mines. As a rule the rich veins are narrow and uncertain, and railroads looking to permanent returns hesitate to build into a region of "one man" fissures or rich pocket deposits, but hesitate less to invest large sums for construction in districts where large ore bodies promise some degree of permanence from their size alone, even if low in assay.

It may be stated in the outset that so far as my observation goes the mines of the Boundary Creek District belong to the latter class. The ores are very low grade, but the ore bodies large, if irregular. Nature has compensated to a great extent for the grade of the copper ore by making it self-fluxing, so that probably nowhere on this continent can smelting be carried on more cheaply, given fair railroad rates and fuel at a reasonable cost.

It is also nothing but simple justice to say that Boundary is today a producing district *because* of the railroads; that it is doubtful if there is a mine within its borders that would pay except at very favorable freight rates and reasonable coke charges. It certainly required considerable courage and considerable faith to build the Columbia and Western Railroad, and no one making the trip from the Columbia River to Phoenix can fail to realise at what expense such excellent railroad facilities were supplied to the various camps. But it is not enough for railroads to build into a district such as this; they must be prepared to handle its product at a minimum cost and to bring in the timber, machinery, supplies, and fuel at the very lowest rates that will pay, if the prosperity of the country is to be established and maintained. There is little or nothing in the way of traffic to be gotten out of the Boundary District, excepting that produced by or relating to the mines.

I ought to say in the outset that my personal observation of the Boundary District has been limited, but from many assays and analyses of its ores; from having handled its entire copper product since it became productive, and from the reports of mining engineers who have carefully examined for me several of the camps other than Phoenix, I feel confident that I know pretty well the characteristics of the Boundary mines and of their ores, and know what may be reasonably expected of some of them, and what has been their record.

Geology.—It is not my purpose to go into the complicated geology of the Boundary District. This has been studied with the usual painstaking accuracy of your Geological Survey, and I understand that the results are soon to be made public.

From such personal observations as I made it is plain that the district is one of great disturbance; that within very small areas almost every variety of later and earlier igneous rock can be found, with the faulting, crushing, folding, and metamorphosis due to these. This is nowhere more apparent than at Phoenix.

I may venture to generalize with the assertion that the ores of Phoenix Camp are almost exclusively altered limestone. On the north side of the ravine which divides the town, the limestone cap is in place, massive and unaltered save by the pressure which has crystallized it, the outcrops of ore being largely at contacts between intrusive eruptive rocks and the body of the limestone. This is notably true of the outcrop at the Brooklyn Mine, where the uplifting of the limestone by the intrusive igneous rock is very marked, and along the vertical crushing zone there has been a second flow of pasty porphory, forming in the most interesting manner a brechia containing sharp, angular pieces of unaltered limestone and of the older porphory. I may say here that in using the term "porphory" I generalise, not having attempted to distinguish the varieties of eruptive rocks, extending vertically or horizontally between the granites and limestones, or filling fissures in the granite itself. These igneous rocks have doubtless received careful classification at the hands of the Survey. In the mines on the north side I am informed that the ore bodies exist in irregular masses of great size in unaltered lime, largely resembling caves which have been refilled with the ore bearing material. The average ore of the best developed mine, showing nearly 500,000 tons in sight, is said to contain 38 per cent. of silica, 16 per cent. of oxide of iron, 15 per cent. of lime, and about 4½ per cent. of sulphur, copper 1.80 per cent, besides gold and silver.

In all of these claims on the north side of the ravine the ore is frequently cut off unexpectedly by vertical dykes or horizontal floors of porphory in a way which would be the despair of those whose duty it is to develop the property, were it not for the great size of the bodies when found. On the south side of the gulch of Phoenix I venture to affirm that the mountain was originally divided by a strong dike of fine grained felsite, which crops out boldly in the railroad cut where it crosses the Victoria claim, and is traceable for 4000 feet to the south, crossing the Aetna and disappearing on the War Eagle. This dike has not been cross-fissured by any subsequent geologic action, so far as can be observed by its appearance on the surface and at depths attained at present, or by the result of exploration with the diamond drill which has penetrated it for several hundred feet at various depths and in different directions from the westerly side. It seems to me probable that on both sides of this main dike, which forms a sort of wall, and for a thousand feet or more to the east and to the west, the limestones originally overlying the granite, shattered by innumerable disturbances and cross-fissured by secondary intrusions, have been mineralized and entirely altered by the solutions following up the main igneous dike and spreading, until nowhere that I could observe was the limestone left unaltered, so practically all of the original limestone that was not eroded has been mineralized to greater or less extent. There is everywhere a notable quantity of calcite, a secondary redeposit of the lime.

To the east of the dike which divided the Phoenix Hill the same general characteristics are noted which I have outlined above, being observed on the Gold Drop and Snow Shoe Claims, and on the Monarch, except that on the Knob Hill, Ironsides, and other westerly claims there is a large, altered, oxidized zone, in which the copper is carried by magnetic iron oxide, while on the easterly side the iron cap is not so extensive.

The Ore.—I have already stated that the ore of the mines on the north side of the gulch of Phoenix is said to contain on an average 38 per cent. of silica, 16 per cent. of oxide of iron, 15 per cent. of lime and 4½ per cent. of sulphur, there being little change between the surface and lower ores so far as the chief constituents are concerned.

This is about the composition of the lower ore from the south side, although many other conditions are distinctly different. The upper ores are largely oxidized and, as stated, consist of massive magnetic iron ore carrying copper sulphide and gold; this surface ore changing at an average depth of perhaps 25 feet to ore more nearly resembling that of the Brooklyn, the iron being largely combined with sulphur, or sesquioxide, rather than in the higher oxidized form. By mixing these surface ores with those from lower levels an ideal mixture is obtained, enabling the furnaces to produce directly a 45 to 50 per cent. copper matte, carrying practically all of the gold and silver which the ore contains.

I have said something about the characteristics of these ore deposits at or near Phoenix, but nothing concerning the quantity of ore which may be depended upon. Of course "available" ore depends on cost of treatment and price of its valuable constituents. With adequate railroad freights and fair charges for coke it is probable that there are reasonably in sight in the Phoenix Camp today several million tons of ore, which with copper at 12½c per pound could be treated successfully. In Deadwood Camp the ore deposits are also enormous, averaging over 130 feet wide, and so situated that surface working can be prosecuted by quarry, a single drill dislodging a train-load of ore in a day. But the problem of mining the lower levels of all these mines without excessive cost of timber or the permanent abandonment of one-half or one-third of the ore, necessarily left in pillars, must be causing serious thought. The tonnage that can be extracted from the mother lode is also up in the high figures, and cheap smelting a welcome fact.

There have been numerous published guesses as to the grade of these Boundary Creek Ores, and this after all is the vital point from which all the others depend. On the north side of the Phoenix ravine the large amount of ore developed is estimated to run about 1.80 per cent. copper, $2.40 per ton in gold, and 25c per ton in silver. The workable ores from the south side of the Phoenix ravine contain on an average copper 1.70 per cent, gold $1.60 and silver 33 cents per ton. The ore from the easterly side of the main dike, dividing the Phoenix Camp, as represented by the Snow Shoe, Gold Drop, etc., probably runs by the carload as shipped about 1.60 per cent of copper, $1.50 in gold and 30 cents in silver. The run of the mines in the Greenwood Camp, as shown by the smelter returns, is probably 1.60 per cent. of copper, $1.80 in gold, and 50 cents in silver.

I may say that I have had unusual opportunities for ascertaining what are the facts. In arriving at these figures I have not been obliged to depend on statements of managers. The entire product of the Granby Consolidated Mining, Smelting and Power Company and of the Briti h Columbia Copper Company passed through the hands of my firm, Ledoux and Company, and from the freight records it is readily ascertainable from how many tons of ore came the matte and blister copper which we have handled. The statements given me of ore mined tally with those of the railroad company representing ore delivered to the smelters, and the statements of the superintendent as to the grade of this ore tally closely with those figured from the copper matte handled by us in New York, checked again by my personal investigations on the spot.

I was accorded every facility in several cases both for ascertaining the ore in sight and the relative assays of the product from different claims. The Granby Company, especially, has kept complete records of all shipments from each claim, not only because this was a proper business policy, but because prior to the recent consolidation of the various interests now included in the Granby Company the Knob Hill, Ironsides, Victoria, and othei claims were owned by separate corporations, so that it was necessary to render separate statements of the ore shipped from each claim. It may, therefore, be taken as a safe estimate that the very large amount of ore available in the Boundary District will vary from 25 pounds to 35 pounds of copper per ton of 2000 lbs., with from 25c to 40c of silver per ton, and from $1.50 to $2.50 per ton in gold. It may be stated that there are some mines, like the "B.C." near Eholt, whose ores as shipped contain considerably more copper than the above, but the figures I have given are well within the limits for the average.

Costs.—Next to the quantity and grade of ore, the all-important question is how cheaply can the values from these Boundary ores be extracted and marketed.

I may say that one of the objects of my last visit was to enable me to assure prospective buyers of the product of the smelters that they could safely depend upon the tonnage contracted for, and need not fear a sudden stoppage from lack of ore. Theie had been various rumors prevalent in New York, such as that only the surface ores were being mined: that these surface ores were richer than those lower down: that when depth was attained costs of mining would prohibit shipments: that the costs of mining were necessarily excessive considering the grade, because the ore was sorted by hand: that only surface ores were self-fluxing, etc., etc.

It is easy to disprove the statement that only surface ores have been treated, because the records at the smelters show from what portion of the working, as well as from what particular claims, shipments were made. For instance, take the Knob Hill Mine as an example. During the year 1901 there were mined:

From the surface	6	per cent.
" " 200 ft. level.....	57	"
" " 250 ft "	19	"
" " 300 ft. "	18	"
	100	"

Taking the Ironsides and Knob Hill together for the years 1900 and 1901, the figures show that 74 per cent. was from below ground and 26 per cent. from surface ore, varying with the time of year. In the summer time a great deal more ore was taken from surface workings than from beneath; in the winter time surface mining was largely interrupted. The cost of mining these large ore-bodies in the Boundary has varied from $1.66 per ton to $2.10 per ton, the first mentioned figure being the more recent. It is a difficult problem, as I have already hin.ed, and the one uncertain element in the prosperity of this district, how to handle the very large ore-bodies without the risk of caving and ruining the mine, on the one hand, or the necessary employment of excessive amounts of timbering, or leaving in the mine large blocks of pay ore as a support. The management of the companies have been studying the problem and the Granby Company have commenced ore-handling with steam shovels, and propose to still further decrease the cost of mining by stripping from the surface down to the present level of the railroad track, and by the introduction of the caving system for lower workings.

Smelting Costs.—It has been seen that cost of mining in the district, even with high wages to miners, is very low, the conditions being most favorable. I come now to the all-important statement of these smelting costs.

The Boundary ore being self-fluxing, indeed rather basic in character, allows the admixture of a certain quantity of silicious ores from the Republic Camp or other districts whose ores carry gold and silver, and the sulphur being low permits of smelting without preliminary roasting. With the advent of railways from the south the Boundary smelters can procure more dry silicious ores at profitable rates. It may also be stated at this point that the freedom of the ores from bismuth, arsenic and antimony renders it easy to obtain a ready market for the copper product.

In considering the cost of smelting it is also necessary to take into account the losses in slag and otherwise. I was allowed to sample the slag dumps and to take portions of weekly slag samples which had been preserved in the laboratory. Before the establishment of bessemerizing the slag loss of the Boundary smelters averaged copper 0.46 per cent, gold 12 cents per ton, and silver 3 cents per ton. With a consumption of about 11 per cent. of coke, and with freight charges as they exist today the cost of smelting at the most favorable location in the Boundary District, after charging against the smelter the costs of marketing the product, must be considerably under $2.00 per ton. Adding the present cost of mining, the total outlay for mining and smelting must be less than $3.66 per ton.

With the introduction of caving and steam shovels at mines, and of bessemerizing at smelters; with further reductions in cost of freight and fuel, sure to come with or without the advent of competing railways, I unhesitatingly affirm that the copper ores of Boundary should be mined, smelted and their contents marketed with profit with copper at 12 cents in New York, and as railway extensions make other ores available that can be purchased cheaply, the profit should increase. But there must always be, as elsewhere, many shipping mines too small to justify their own individual smelters, and mutual co operation and a broad business policy should allow them all to prosper.

Coal Mining in the North-West Territories and Its Probable Future.

By Frank B. Smith, B.Sc., M.E., Calgary, N.W.T.

This vast tract of land with which I will try to deal is too extensive to treat with in detail, but as far as possible I will give a general outline of the coal mining and its value.

The Territories were at one time known as the Indian Territories, but have now been formed into an organized district with a Legislative Assembly. The North-West Territories, however, is the only settled organized district in the Dominion with a Legislative Assembly that has not been granted autonomy.

The area of the three districts which is governed by this Assembly is about 304,340 square miles and comprises the districts of Alberta, Assiniboia, and Saskatchewan. Each of these districts has about an equal area, and are divided from each other by imaginary lines of longitude and latitude.

On the south we have our American cousins, separated from us by the 49th parallel; in the west we can shake hands with our British Columbia neighbors over the summit of the Rocky Mountains until the 54th parallel is reached, then from that point northwards we are divided from them by the 120th meridian of west longitude. On the north we have only a few Indian friends who cross and recross about the 55th parallel at their own sweet will. In the east our Manitoba friends are anxious to extend their boundaries from about the 102nd meridian of west longitude to a point as far west as they can reach, so as to secure a part of the valuable asset in the lignite coal fields of south-eastern Assiniboia.

He would truly be an imaginative writer who could picture the scenery over the 1,000 miles he would require to travel from the eastern to the western boundaries of the Territories. From the immense tract of level prairie, with its waving fields of yellow grain, to the rolling, grassy plains of the foothills, studded with cattle, until the traveller would strike the seemingly impenetrable mural escarpments of palæozoic rocks; and again, should he make a journey from the International boundary northwards, these former scenes would be repeated with many diversities, leaving the rich ranching plains of southern Alberta, crossing stream and lake until he reaches the valuable timber belts of the northern country, with its well stocked limits of wild game.

Geological.—The very important consideration, however, for settlers on these vast plains is the question of fuel, and thanks to a bountiful nature there is an unlimited supply of this necessary article within easy reach of every one, as I think it might be truthfully said that there is no point on this immense area that is more than sixty miles from a coal-bearing belt, either developed or lying dormant.

In the eastern portion of the Territories, as far as the eye can reach, there is not a tree or shrub to be seen, except it may be a few small scrub cottonwood on the banks of a river. The fuel supply here, then, is obtained from the lignite beds of the Larimie series. The seams vary in thickness from 2 to 8 feet, although at some points they have been found to attain a thickness of 18 feet. The coal underlies the level prairie at a depth of not much over 100 feet and the coal seam is usually overlain by soft, soapy sandstones and clays. The exposures along the Souris River are well defined, and the coal easily obtained by an adit level driven in from the river bank at a height of about 30 feet above the water. This lignite coal has a great tendency to disintegrate where exposed to the atmosphere on account of the large percentage of hygroscopic and combined moisture. An analysis from an average sample of this section is as follows :—

Moisture	16 92	per cent.
Volatile combustible matter	38.58	"
Fixed carbon	40.72	"
Ash	3.78	"
Total	100.00	"

This coal, however, will stand transportation in box cars and for some time withstand the action of the weather without being hermetically sealed as has often been sarcastically stated. The coal is lamellar in structure, but when freshly broken sometimes shows a conchoidal fracture and much resembles some cannel coals. Journeying further west we come to the coal of the Medicine Hat district, which is also a true lignite, but is an intermediate coal between the Souris lignites and the lignitic coals of the Bow and Belly River near Lethbridge. The coal of this district is very similar to the Souris coal in structure, although containing from 4 to 6 per cent. less moisture, but still has the tendency to split into angular fragments when exposed to the atmosphere. The next important point we arrive at is the Lethbridge coal field, the coals of which are termed lignitic and are much superior in quality to those lying farther east. The coal area in this district forms a low-lying synclinal between Lethbridge and the foothills, but even here we seem to trace in the workings of the Lethbridge Colliery, by faulting, the extreme limit of the waves caused by the tremendous upheaval of the Rocky Mountains The coal, as has been already mentioned, is superior in quality to that farther east, and the closer we approach the foothills this becomes more marked, the coal containing less moisture and more bituminous in character. Whether this alteration has been produced by superincumbent pressure or metamorphism caused by the upheaval of the Rockies is a matter rather difficult of determination. A comparison of four different analyses of coal will admirably show this transition:

	Souris.	Lethbridge.	Blairmore.	Anthracite.
Moisture	16.92	12.08	2.07	0.71
Volatile	38 58	26.87	22 84	10.58
Fixed carbon	40.72	54.93	68.35	82.14
Ash	3.78	6.12	6.74	6.57
	100 00	100.00	100.00	100.00

Approaching the foothills of the Rockies, the coal assuming a more bituminous character has in many cases proved to be of good coking quality, although not equal to that of the Crow's Nest Coal Co. on Elk River, will still make a formidable rival in the smelting market.

The coal seams in the foothills are more numerous than on the plains and occupy a lower horizon in the Cretaceous series, no doubt being of the same contemporaneous age as the Cretaceous coal beds of Vancouver and Queen Charlotte Islands.

The Palæozoic rocks of the mountain ranges, with a general trend from S.E. to N.W., protrude through the Cretaceous strata, and form many detached troughs of coal beds hidden away in the valleys, the coal seams repeating themselves along lines of folding and varying in pitch from 10° to vertical.

Physical Geography.—To gain any idea of the physical features of this western country at the time of deposition of all these coal beds would require more data than we at present have, but some crude scene might be pictured of the general features. With the climate intensely tropical it seems probable that there was a vast swamp at least from the 55th parallel in the north and extending far south into the States and from the western borders of Manitoba to Vancouver Island in the west. This swamp being surrounded by high Silurian and Carboniferous mountains with numerous islands of the same geological age dotted all over it.

The area of these older rocks must have been considerable when we begin to examine the general thickness of the Cretaceous deposits as exposed in the mountains, forming at least a thickness of 3,000 feet, composed chiefly of conglomerates, sandstones, shales and coal. The earth's movements at the time of the Cretaceous era was no doubt extensive, but the general upheavals and subsidence of this part of the continent, from all indications, was more of a wavy movement than the sudden movements which subsequently happened to this area. The sandstones as a whole must have been deposited in shallow waters, and

movements frequent, as seldom can one find anything but false bedding exposed. The great movement which subsequently took place, throwing up the great white limestone mountains, has defaced the previous physical configuration and with denudation, actions of the last glacial epoch and other forces of nature have left to us still, however, an immense monument of wealth.

Coal Mines in Operation.—The coal mines in operation over this vast territory are numerous, but few of them as yet have amounted to much more than a prospect or that of supplying the local consumption.

The principal mines are those of the Alberta Railway and Coal Co., at Lethbridge; the H. W. McNeill Co., at Canmore and Anthracite; the Souris Coal Mining Co., at Coalfields, Assa., and the Canadian-American Coal and Coke Co., at Frank, Blairmore District. Outside of these there are over thirty small mines working at Estevan, Medicine Hat, Edmonton, Knee Hill, and Sheep Creek all supplying the local trade.

The Alberta Railway and Coal Co. are now hoisting coal from only one shaft, with screening, loading, and general pit-head arrangements of the most modern type.

The room and pillar method is here adopted for working, being more suitable for flat seams of this kind and more economical The system, however, has been improved on here on account of the cover and the character of the roof and pavement. Two parallel entries are driven north and south with cross cuts between them every 60 feet for ventilation; from these entries rooms are driven off every 65 feet, with a narrow neck of 15 feet from the main entries then opened out to room width, which is from 20 to 22 feet. When these rooms have been driven a distance of 150 feet they are cut off by another single entry running parallel to the main entry. This constitutes what is termed the four entry system. From this 3rd or 4th parallel entry as the case may be, rooms are driven off at right angles with a narrow neck a distance of about 34 feet apart and continued room width for a distance of 250 feet, which is the limit unless special emergencies arise. These rooms driven 250 feet in the solid, are connected about every 90 feet by cross-cuts and, when the limit has been reached, long wall retreating begins and is carried on till it reaches the 3rd or 4th entry, and part of the pillar is also taken from the lower side of these entries. This 3rd or 4th entry is cut off by a slant from the main entries about every 800 feet, so that all rails may be drawn from the long-wall retreating, and a pillar of at least 130 feet left each side of the main entries, which has been found ample to prevent squeezing until the section is completed and the pillars all drawn from that locality.

The seam is about 5 feet 6 inches thick, and is separated in the middle by a small band of clay varying in thickness from 2 to 6 inches. At this colliery, however, hand mining is practically a thing of the past, as both rooms and entries are cut by the Ingersoll-Sergeant punching machine. This cutting work is carried on double-shifted and the blasting and loading completed by the loader on the day shift, who is not necessarily a thoroughly practical miner, but at this work unskilled labor can earn from $2.50 to $3.00 per day.

The mine development is carried on very systematically and their system of endless rope haulage is equal to any on the continent, the auxiliary horse haulage seldom exceeding 1,000 feet. Their banner hoisting day has been reached this year, a tonnage of no less than 1577 tons being hoisted from one shaft in ten hours.

The ventilation is produced by a Capell fan, which is capable of producing 100,000 cubic feet of air per minute. This company also owns the narrow-gauge railway from Lethbridge to Great Falls, U.S., with a branch line running west tapping the finest ranching and grain country in the Territories, now that it is being watered from the irrigation canal supplied by the waters of the St. Mary's river.

The mine at Canmore, operated by the H. W. McNeill Co., is another steady coal producer, supplying all the steam coal used on the line of the Canadian Pacific Railway between Calgary and Revelstoke. Their system of working is the pillar and stall, which within the past two years has been modified by working across the pitch instead of up the pitch as formerly followed. This modification has been fully discussed in a former paper before the Institute by Mr. O. E. S. Whiteside, and to add anything to it would be presumptuous on my part, but this I must say, that I consider it will certainly reduce the number of accidents, and a less liability to accumulation of gas; also the amount of coal recoverable will be greatly to the advantage of the operators.

The number of seams being worked in this field are four, varying in thickness from 3 to 6 feet. The seams as a whole are clean, shipped direct into the cars and used on the locomotive as run of mine coal. The area of this field is curtailed by the close proximity of the limestone range, and from this cause also considerable faulting and folding is encountered which tends to make economical working a matter of great anxiety to the management.

Ventilation is here produced by two fans capable of producing about 80,000 cubic feet of air per minute, but each having separate districts to ventilate and acting entirely independent of one another.

The H. W. McNeill Co. also operate the mine at Anthracite, which produces about 100 tons per day. The coal here produced is equal in value to the Pennsylvania Anthracite, although just an advanced stage of the Canmore bituminous coal altered by metamorphism. The system of working is similar to that at Canmore, and ample ventilation is supplied by a force fan. The field here is considerably more disturbed as it approaches the west, but a new concession has been obtained in the eastern portion of the field which will ensure a steady output and a supply of this quality of coal in the market for many years to come.

The Souris Coal Mining Co., Ltd., operate four mines in south-eastern Assiniboia and have a shipping capacity of 500 tons per day. The mining is mostly accomplished by punching machines of the Harrison type. The seam is about 8 feet thick of clean coal, and burns to a very fine woody ash. Ventilation at present is produced by a furnace, but it is contemplated in the near future to install a fan.

Consolidation of all the small interests has taken place in this district lately, and will tend to give an impetus to mining in this locality which is impossible where so many small concerns are operating without railway facilities.

The Canadian-American Coal and Coke Co. operate one mine at Frank, which has been opened by two adit levels, and the whole development, for a producer of 500 tons per day, completed in one year. The seam has a thickness of 12 feet and stands nearly vertical with a footwall of hard sandstone and a hanging wall of metamorphosed shale. The system of working is a combination of pillar and stall and long-wall, rooms or long-wall being worked for a distance of 90 feet, and then with a pillar of 40 feet left with a manway in the centre and cross-cuts from them to the rooms Most of the coal at present is left in, but will no doubt be nearly all recoverable when the pillars are being drawn. Ventilation is produced by a 4-ft. Murphy fan, forcing into the workings and producing 20,000 cubic feet of air per minute. Six bee-hive ovens for coke testing have been built at the mine, and the coal has been proved to produce a strong coherent coke.

The mines in the other districts mentioned are carried on in a systematic manner, and all of them as far as consistent complying with the Coal Mines Ordinance.

Mining Laws.—About ten years ago mining regulations were drawn up by the Legislative Assembly and an inspector appointed to see them carried out, but on account of the great increase in coal mining in the Territories within the past few years, a new Ordinance was passed in 1898 by the Assembly which practically covers all the requirements carried out in other Provinces of the Dominion. A few alterations of course will be made from year to year, and one point which I consider

should be carried out by all Provinces regulating coal or metal mines, and that is in the matter of enforcing a supply of all ambulance requisites being kept at the works. With regard to this ambulance work, great progress has been made in recent years by reason of the facilities for training which can now be obtained under the auspices of the various ambulance associations throughout the Old Country. If it was made compulsory that these ambulance requisites had to be kept at the works here, then we would soon have the medical men of this country also take up courses of lectures on the subject, and after a full course the students subjected to a thorough examination to test their fitness for undertaking the preliminary treatment of an injured person until a properly qualified practitioner arrives to take charge of the case. To those successfully passing this examination on ambulance work or first aid to the injured, a certificate of merit or proficiency might be awarded. The appliances required at every colliery or public work includes stretchers, boxes containing splints, bandages, tourniquets, needles, thread, antiseptics, oil paper, sticking plaster and other odds and ends. These requisites should always be kept in a place easy of access, and in the case of a colliery in the weigh-house on the pit-bank.

This matter, if taken up by the management, which is most desirable, would save many a laboring man hours of suffering and earn for the employers eternal gratitude from their employees.

Probable Future.—It might reasonably be asked why the development of this vast field of wealth has been so long delayed, but the answer does not require much enquiry for when a glance at the map is taken. Want of railway facilities to reach a foreign market, the sparseness of population and no industries to make a home market The coal mining of the past in the North-West Territories has been one long struggle for the companies operating to keep their head above water, but the dawn is now approaching and the cloud begins to show its silver lining.

Since the building of the Crow's Nest Pass Railway a magnificent stretch of country has been opened out, and the prospecting which has been carried on in that Pass for the last year has shown to the country a wealth of coal which is daily directing capital towards it.

The long-reaching arm of the Canadian Northern Railway will pass through the northern end of this coal belt, and as the country is settled closer to the foothills numerous additions will be made to our knowledge of this inexhaustible coal field. The coal of the foothills has been proved to be of good coking quality, and the past year marks an era in the history of the North-West which for generations to come will stand out pre-eminently as the golden year of the Territories.

To attempt to estimate the quantity of available coal in the Territories would be to attempt the impossible, but from what we know of the natural exposures and what has been proved, will ensure for us centuries of consumption and a surplus for exportation which will make of the North-West a Province second only as a coal producer to the State of Pennsylvania.

In the districts of Souris, Medicine Hat, Lethbridge, Red Deer, Edmonton, &c., the estimated quantity of coal per square mile is from 5 to 12 million tons and practically inexhaustible as a domestic fuel. When this point is conceded, it possesses no additional meaning when we attempt to estimate the quantity of coal buried in the foothills except for steaming and coking purposes it will be an immense source of wealth to the country. There are many points in the foothills coal area which will bear an immense amount of labor in prospecting and boring. The data thus gained will be of immeasurable value to the country, both scientifically and commercially. Part of this work, especially boring near the foothills, might receive Government aid.

In conclusion, I am sorry to say that the information here given is not as complete or probably as accurate as it might be, but I trust what I have said will be some matter for reflection for a few minds, and probably may be the means of directing additional capital to the development and settlement of this vast area.

Compressed Air.

By W. L. Saunders, New York.

In introducing the subject of compressed air before the members of this Institute, I feel that I am addressing those who are not only interested in the subject, but through the discussion which will follow I hope to gain a good deal of practical information. To me compressed air has been a close study and a pleasant pastime for more than twenty years, and yet every time I attempt to climb up on a pedestal and pose as an expert, I see all around me things that I did not know. Though one of the oldest of the sciences, there is really less known about compressed air than about steam, hydraulics or electricity, and however deeply we may dig into the theories of thermodynamics, we find every now and then a practical mining engineer who shows us by a little experience that the formula which has been guiding us is nothing but a cobweb without substance or strength.

I remember very well my first researches on the subject of compression. After learning what was meant by isothermal compression, it appeared very plain that a serious loss was suffered to take place in the cylinder of an air compressor by attempting to compress without injecting a spray of cold water into the cylinder during the process. All theories and most authorities taught me to advocate the "wet" type of compressor as distinguished from the "dry," and yet it is a fact that at the present time I do not know a single builder who follows the wet process. It must not be inferred, however, that the importance of cooling during compression was over estimated. We have learned to cool by compressing in stages and have abandoned water injection because of its complications of apparatus, the inevitable destruction of wearing parts, and because it is not advisable to bring air and water together while the air is at a high temperature. The reason for this is that the capacity of air to take up moisture is in direct proportion to its temperature, and even with the most efficient system of spray injection it is difficult to start the compressed air on its journey to the mine at a temperature low enough to produce dryness. During the building of the Washington Aqueduct Tunnel a central air compressing plant was located at the foot of a hill. The transmission pipe leading up the hill to the shafts would at times become practically filled with water which would be taken up and sent forward like a piston into the workings. It is interesting here to note that this difficulty was overcome by pumping fresh cold water into the air receivers at the foot of the hill, thus condensing the moisture of compression. Dry stage compression actually gives as a pressure line more nearly the isothermal than was obtained by the injection process. In stage compression there are two or more air cylinders each surrounded by water jackets. Intercoolers are placed between the cylinders, and in this way the air is alternately compressed and cooled until it is discharged into the receiver. By this process the air is maintained in a dry condition, and as it at no time reaches a diabatic, or the heat maximum of temperature, it is not "burned," but is delivered into the mine in a fresh and healthy condition. Too little importance is sometimes given by engineers to the intercooler. The The common or cheap form of intercooler only partially serves the purpose, but the intercooler which is composed of nests of tubes around which the air circulates, splits up the air into thin layers and as cold water passes through the tube these thin layers are rapidly reduced in temperature; so that with cold water, which I judge is not difficult to obtain in Canada, it is quite possible to obtain air temperatures in the intercoolers considerably lower than was the temperature of the air before it entered the compressor. This is an important point as affecting both the actual and the volumetric efficiencies of the air compressor. The theoretically perfect compressor is one which draws in air at a temperature of zero or lower and discharges it compressed at normal or outside temperatures. We must always bear in mind that during com-

pression the temperature of the air at any stage depends upon its initial temperature, and that the higher the initial temperature is the higher will be the temperature throughout the process of compression. This is not a theoretical but a practical question, which concerns those who are engaged in the every day practice of air compression. Engine rooms are usually warm and dirty places from which to draw a supply of air for the compressor. Hot air means thin air, and thin air drawn into a compressor means a low volumetric efficiency. The mine owner who pays for an air compressor of a certain size naturally wants to get out of it all the compressed air he can. He should therefore see that the compressor draws air from outside the engine room and from the coldest spot on the property. He should also see that his compressor is provided with a thorough system of cooling, because no matter how cold the air may be, when it goes into the compressor it is sure to warm up by the action of the piston. This warming up process causes the air to expand and to resist the act of compression in degree directly in proportion to the increased temperature—that is, the hotter it is, the harder it is to compress the air and the more power is consumed for a given volume To express this in figures, we find that when air is compressed in a single stage machine from atmospheric pressure and 60° Fahrenheit temperature to 80 pounds gauge pressure, the maximum theoretical loss due to increased resistance through heat is about 33 per cent., when represented in foot pounds of work. As a matter of fact no such loss is ever suffered, because maximum temperatures are never reached even in single stage compressors, cool metallic parts brought in contact with the air absorb some of this heat, so that we may safely say that a well designed water-jacketed single-stage compressor suffers a loss of 20 per cent. in foot pounds of work when compared with isothermal or perfect compression, and under the conditions of temperature and pressure stated above. We may therefore say that in compressing air to 80 pounds pressure without compounding, it is possible to lose one-third in power though we usually lose one-fifth. To illustrate with these figures the importance of compounding, I would state that under the conditions stated a two-stage compound compressor, when properly designed, would suffer a loss of a fraction over 15 per cent., and in a four-stage machine we are able to get this down to near 5 per cent. As some of you may be using air at 100 pounds pressure, you may be interested to know the figures under these conditions. The maximum loss in a one-stage compressor is 38 per cent.; this in a two-stage machine may be brought down to a fraction over 17 per cent., and in four-stages to 8 per cent. Even at 1,000 pounds pressure the heat loss in a four-stage compressor is brought down to 17 per cent. All representing foot-pound of work.

The subject of cooling is not complete without a brief statement about after-cooling. It is easier to get our ideas about intercooling carried out than it is to get any hearing when we talk about after-cooling. Assuming that you agree with me that air should be cooled before it enters a compressor and that this process of cooling should go on *during* compression, I would also like you to agree that even after we have bottled up the air in the receiver something might be gained by inflicting it with a further and final cold bath. This is really the last time that the cooling process should be applied, and from this time on we are to turn square about, reverse our treatment, and begin to warm up. An after-cooler between the compressor and the receiver, or just outside the receiver in the main line, is a good thing because it will serve as a condenser to abstract moisture from the air by bringing its temperature below the dew point. Air at all times contains moisture, the average moisture being about 50 per cent. of what is required to produce saturation, and it is safe to say that during our cooling process in the compressor we are not likely to abstract any of this moisture. The only mechanical way as distinguished from the chemical process by which we may get moisture out of air is to lower its temperature. But we must lower it below its initial temperature to produce any results. Notwithstanding the best systems of jacketing, compounding and intercooling, the compressed air is usually discharged into the receiver at a temperature about double the initial temperature, and as this air cools on its journey to the mine, it is likely to condense moisture on the interior walls of the pipe In cold weather this freezes and accumulates, sometimes restricting and even stopping the passage of the air. In other cases it condenses its moisture in the ports and passages of the drills and pumps. These troubles can be reduced to a minimum and even overcome entirely by a thorough system of after-cooling, which means nothing more than reducing temperature and abstracting moisture just outside of the engine room.

Before leaving the subject of compression, I would say a word about oil. Air cylinders do not require oil either in quality or quantity like steam cylinders. What is good for the one is bad for the other. A steam cylinder needs an oil of low flashing point, and plenty of it, because the tendency of the wet steam is to wash the oil out of the cylinder. Not so with air, there is no washing tendency and very little oil will last for a long time. This oil should be of the best quality obtainable and of a high flashing point. It should not be a coking oil, that is when evaporated on a piece of hot metal it should not leave a carbon deposit. This is a subject which has been very much neglected, and this neglect is responsible for much waste of money, and worse than this, for explosions which destroy property and threaten lives. The actual amount of oil that should be used in an air cylinder is one-quarter that which should be used in a steam cylinder of the same size. I would call this a maximum, for very much less will often suffice, especially where the oil is of the best quality. Too much oil where there is a coking tendency results in choking the valves and ports. A discharge valve might stick through coking, and when stuck it will admit some of the hot compressed air into the cylinder against the receding piston, which on the return stroke is compressed and carried to a temperature beyond the flashing point. Sometimes when discharge valves give trouble, they are cleaned by injecting kerosene; this is a fatal error. Kerosene should never be used in the air cylinder, but instead of this, fill the oil-cup with soap-suds made preferably of soft soap, and feed this into the cylinder; let the compressor work with soap-suds instead of oil for a day each week and no harm is done, care being taken to feed with oil a half hour before stopping, so that the parts may not be subject to rust, which is the only danger from soap-suds.

Compressed air has always been and still is supreme in mining. As a means of transmission and for surface work it must in many cases give place to electricity and hydraulics, but as an underground power its supremacy is admitted. No power is so safe, none so free from objections in mining work. It aids ventilation and cools the heading. If the conduit pipe is large enough, you will suffer no loss by friction and may convey compressed air several miles from the generating station. In recent years compressed air economies in production, transmission and use have opened up a large field in directions other than mining. All of our large railway systems are now provided with pneumatic appliances in the shops and many of them use the system for switching. Machine work of all kinds, such as drilling, chipping, riveting, moulding and hoisting is done by compressed air. The air lift pump, for lifting water, salt water and oil from wells occupies a field of much usefulness. The compressed air locomotive has an established place in and about mines, nine of them being in constant operation in the Anaconda Copper Mines in Montana, and several are now at work for the Cambria Steel Company in Pennsylvania. The use of compressed air in bridge and tunnel work has made possible many of these large undertakings. The Blackwell tunnel under the Thames, in England, is one of the most recent evidences of the utility of compressed air for such work. The stupendous scheme, which has been inaugurated by the Pennsylvania

Railroad, to bring its terminal into the heart of New York City, is made possible only by the use of compressed air.

In conclusion, it may be interesting to call your attention to a column of "Donts," which I found in an engineering paper published in far off New Zealand, and from which we may all, I think, carry home some useful lessons.

"Don't install a compressor just about equal in capacity to your present requirements, for when once you have compressed air available its number of uses becomes legion. Good practice is to provide a compressor at least 50 per cent. greater in capacity than your immediate necessities demand. Duplex compressors are made divisible, permitting the installation and operation of one-half at first and the other half later when the additional capacity is needed.

"Don't accept the theoretical capacity of an air compressor stated in the list of the maker, as the equivalent of the actual volume of air needed for your service. Remembering the difference between theory and practice, allow a small deduction for friction, heat, clearance, etc., being unavoidable losses in air compression, before calculating what your actual delivery in compressed air will be.

"Don't buy an air compressor because it is cheap. It will prove the most expensive proposition of its size that you have ever encountered. If a water pump fails in its work, you will know it at once; if a steam engine is deficient, its shortcomings are self-evident, but if an air compressor is poorly designed or badly constructed, it may continue in the evil of its ways until the scrap-heap claims it for its own, unless, as is more than likely, an absolute breakdown calls attention to its deficiencies, and you learn all too late that the hole it has made in your coal pile, added to the loss of keeping it in repair, would have paid a handsome interest on the additional first cost of a properly designed and properly constructed compressor.

Don't buy a second-hand compressor unless you know it has given satisfaction in work similar to your own, and that its working parts retain their full measure of usefulness without deterioration. An air compressor with valves, pistons, etc., worn out or in bad repair, can waste more good power than anything of its size known.

Don't buy a compressor that your neighbor used for operating oil burners because you intend putting in pneumatic tools. For, even if all compressors look alike to you, experience teaches that oil burners operate under 12 pounds pressure, whilst pneumatic tools require 100 pounds, and the oil burner compressor, with unevenly proportioned cylinders, devoid of water jackets, will equal your service as well as a low pressure boiler for heating will run a high speed engine.

Don't use air brake pumps or direct acting compressors. Statistics show that their steam consumption is about five times that of a crank and fly wheel compressor for the same volume and pressure of air delivered.

Don't install a steam driven compressor if your steam supply is short and plenty of belt power available.

Don't put in a belt driven compressor if you have plenty of steam and are short of belt power.

Don't draw your intake air to the compressor from a hot engine-room, or from any point where dust is abundant. The volume of air delivered by the compressor increases proportionately as the temperature of the intake air is lowered, and dust or grit entering the compressor clogs the valves, cuts the cylinders and generally impairs the efficiency.

Don't use any old thing for an air receiver. Compressed air under 100 pounds pressure will leak a horse-power through a 1-16 in. diameter hole in five minutes, and a well made, strong, and tight air receiver is the second essentially important factor if you would realize to the utmost all the advantages which compressed air provides.

Don't connect your air admission and discharge pipes improperly at the receiver. To secure the best results and eliminate moisture from the compressed air, connect your pipe leading from the compressor at the top of the receiver and lead your air pipe to points of consumption from the bottom of the receiver.

Don't have leaky air pipes. Test your piping when it is installed, and at regular intervals thereafter, allowing the full pressure to remain an adequate length of time, and if the gauge indicates leakage locate and remedy it.

Don't install your piping without properly providing for drainage of condensed moisture at regular intervals in the system. The simplest method is to slightly incline the branches leading from the main line and insert drain cocks just before the hose connection is reached."

On the Use of Wood Gas in the Manufacture of Iron and Steel.

By Dr. James Douglas, New York.

Since suggesting in my paper, which appeared in the *Transactions* of 1899, the utilization of the waste wood of Canadian Lumber Mills for the reduction of iron ores and the making of high grade steel, I have been experimenting on the gasification of wood for gas engine purposes. The object I had in view was to make a fixed gas immediately in the generator, and avoid the complication and waste which result from gathering the volatile products of combustion in any form of condenser. We have obtained this object by using the Loomis-Pettibone Generator and apparatus, but modifying their method of working. The essential feature of the Loomis process is that the air and steam are drawn by an exhauster downward, and therefore the volatile products given off on the surface of the charge, in passing through the incandescent lower layer of fuel, are converted into fixed gases. When the apparatus is used for making water-gas from coal, the operation, as described in the pamphlet of the Loomis-Pettibone Co., is as follows:

"In starting fires in the generators, a layer of coke or coal, about five feet in depth, is put in, and ignited at the top, the exhauster creating a downward draught. When this body of fuel is ignited, coal is frequently charged, raising the fuel-bed to about eight feet above the grates, and there maintained. Bituminous coal is generally used, and is charged at intervals as needed through the feed-door in the top of the generator.

"Air is also admitted through the same doors, and, by means of the exhauster, is drawn down through the fresh charge of coal, and then through the hot fuel-bed beneath. The resultant producer, or generator-gas, is drawn down through the grates and ash-pits of generators 1 and 2, values A and B, up through the vertical boiler 3, valve C, to scrubber and exhauster, valve D being closed, and is delivered into a small gas-holder for supply to the furnaces. When the exhauster has brought the fuel up to incandescence, the charging-doors E and F are closed, valve B lowered, valve C closed, and valve D, leading to the water-gas holder, opened. Steam is then turned on into the ash-pit of generator 2, and, in passing through the incandescent coal, is decomposed, forming water-gas. From generator 2 the gasses pas through the connecting pipe shown near the top of the generators, and down through machine No. 1. The gas passes through valve A into and up through the boiler 3, and thence, after being washed in a scrubber, is conducted into a holder. Water-gas is made for five minutes, when the temperature of the fuel-beds having been considerably reduced, the steam is shut off, valve D closed, valves B and C opened, and the charging-doors E and F opened.

"This process of making water and producer gas is alternated at intervals of about five minutes.

"In making the next run of water-gas, the course of the steam is

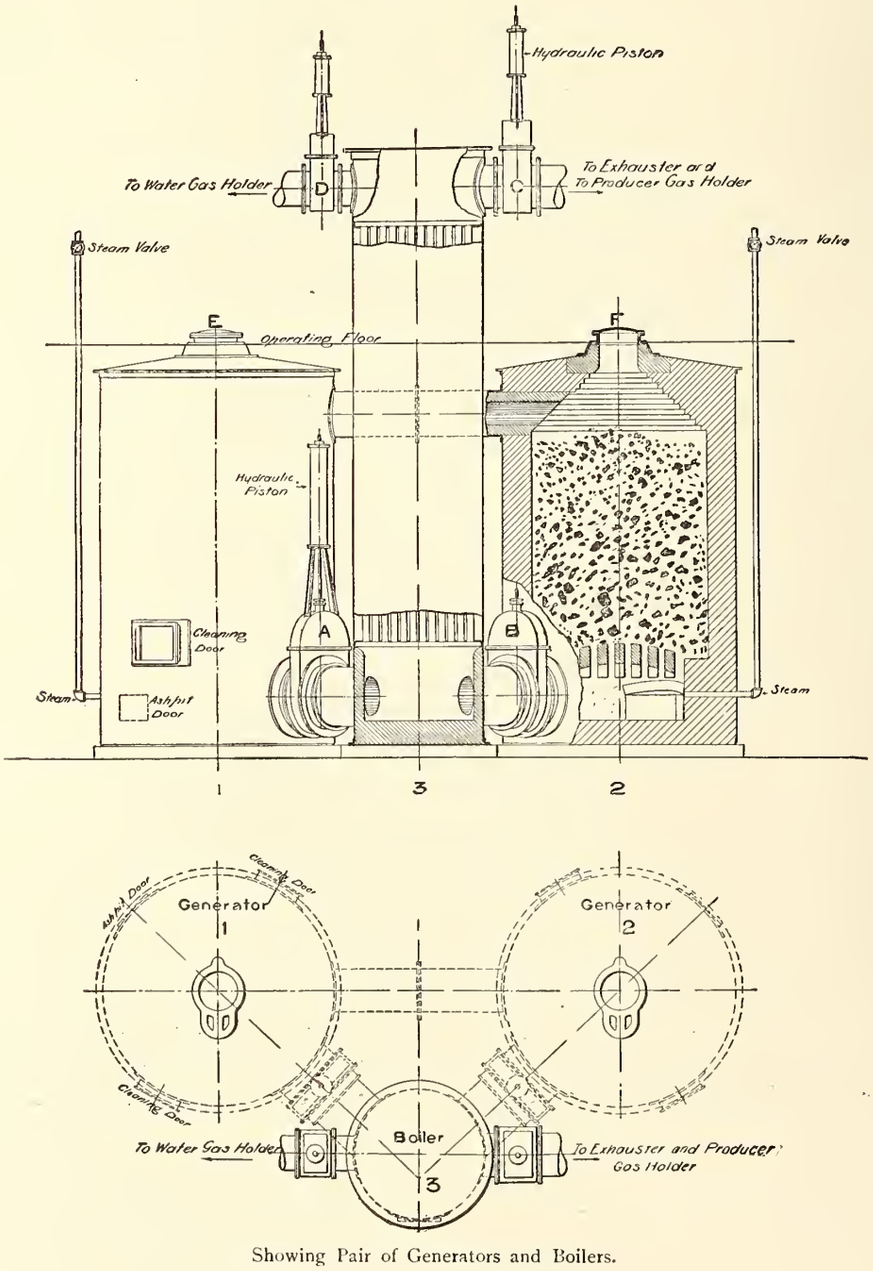
reversed, *i.e.*, valve A is closed, and the steam is turned into the ash-pit of generater No. 1. Valve B is left open, but the other valves, C and D, and the Charging doors, E and F, are operated the same as in the first case.

"While the fires are being blasted, and during the making of a run of water-gas, the hot gases in passing through the boiler give up a large proportion of their sensible heat, which is converted into steam. This in turn is directed under the fires in the generators for decomposition. Another advantage of the double-generator apparatus is that, as all gas is made to pass through the fire, the tarry matter from the coal is converted into fixed gases that can be conducted any distance through ordinary pipe, and at any temperature or pressure. Again, as the steam is forced through two fires, the percentage of condensable water-vapour is exceedingly small."

The process above described is modified at the Nacozari works with a view of making a uniform gas of calorific power, higher than producer-gas and lower than water-gas out of wood. This is effected by introducing very little steam with the air, and drawing the steam and air almost continuously downward through the incandescent fuel. Every half-hour or so the heat of the burning fuel becomes excessive, the feed port is closed, and steam alone in a larger volume is drawn through the layer of fuel. In two or three minutes the temperature is sufficiently reduced to permit of the door being reopened, and of the mixed air and steam being supplied to the charge. The effect of thus drawing the gas, whether water-gas or producer-gas, through a layer of incandescent fuel, is to decompose the tar and all volatile products of combustion so perfectly that little more than a trace escapes to the scrubber, and none reaches the gas-engines, which are situated 400 feet from the gas-holders.

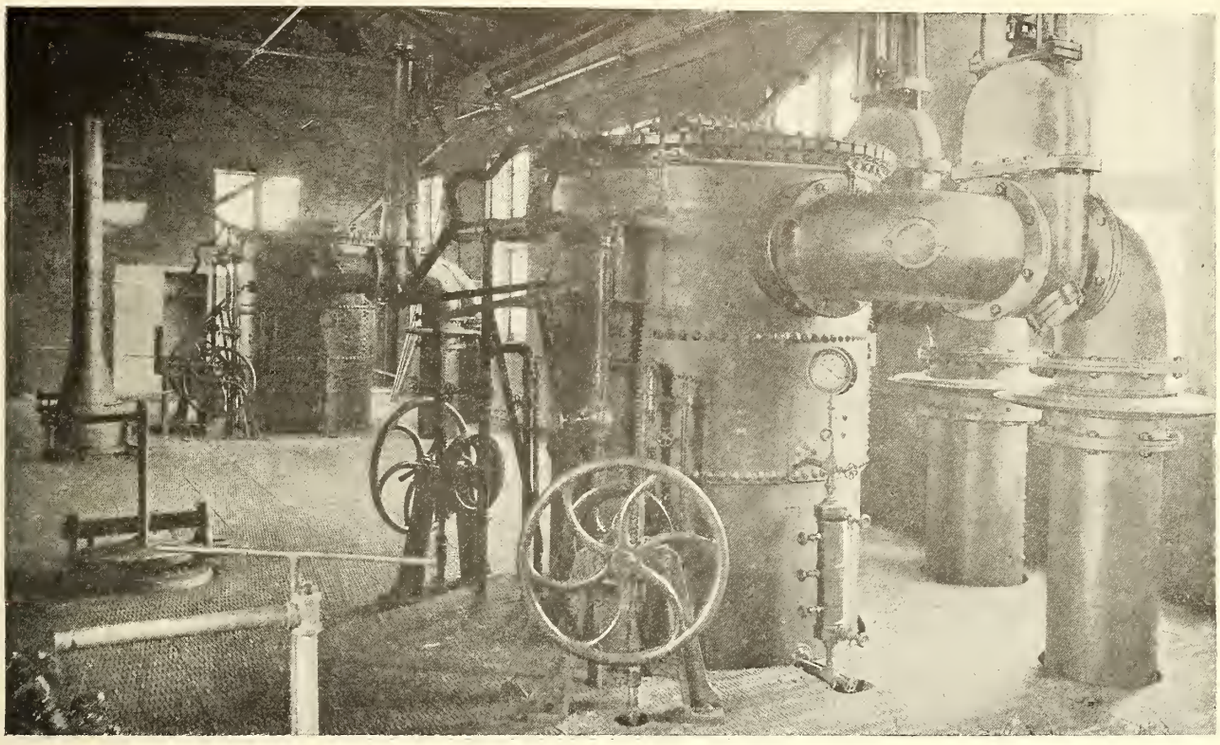
When using wood, a layer of incandescent fuel, coke or charcoal, must be ignited on the grate bars of the generator before the feeding o wood billets commences. The Nacozari generators, having been designed for coal-fuel, are only 6 feet 9 inches internal diameter, and it is found desirable to cut the green wood into lengths of 18 inches, which are fed in the same way as coal through the open port. The feeder, who can see perfectly the surface of the charge, is careful to prevent the formation of cavities, whether the fuel be wood or coal. When using wood, a stack of billets cut into smaller lengths is at hand on the feed-floor for the purpose of correcting irregularities in the surface of the charge. When using wet wood the mixed water and producer-gas is made without the injection of any steam, as the water in the freshly cut wood supplies the necessary steam.

PLATE I.



Showing Pair of Generators and Boilers.

PLATE II.



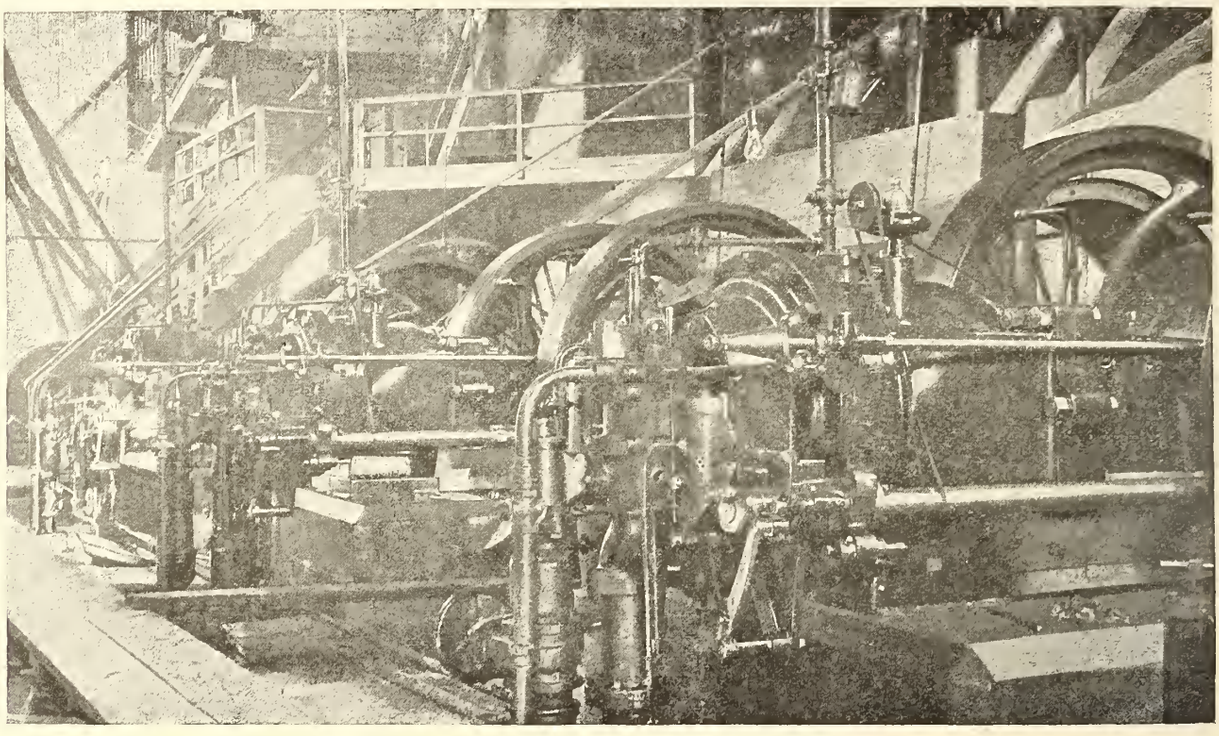
Operating Floor—Winchester Repeating Arms Co.

PLATE III.



Concentrating Mill, Morenci, Arizona—Power furnished by three 80 H P. Gas Engines.

PLATE IV.



The Concentrating Mill is operated by three 80 H.P. Gas Engines, placed in the center of the mill, belted to clutch pulley on countershaft. Two engines are required to drive the mill, one for each side. The third engine is for reserve, thus insuring continuous operation.

PLATE V.



Detroit Copper Mining Company, Morenci, Arizona.—The Gas plant is located between the Smelting and Concentrating Plant, with gas piped three-quarters of a mile from Smelter and one-quarter of a mile to Concentrating Mill. The Main Power Plant at Smelter consists of two 150 H.P. gas engines, each operating a 120 K.W. alternating Electrical Generator running in parallel. Induction motors are used in this department. The Concentrating Mill is operated by three 80 H.P. Gas Engines. There are a number of small gas engines of different makes about the works.

The composition of the mixed gases and their variations from day to day, when made from coal, may be judged of from the following series of analyses taken on consecutive days from the record, two or three minutes being taken to draw off the samples and to make the simultaneous calorimeter readings :—

Gas made from Mixed Anthracite and Soft Coal, Nacozari Gas Plant.

Date			CO	H	CH_4	$Cn H_{2n}$	CO_2	O	N	B. T. U. at 62° F. and Sea Level
2-27	Mixed Gas	Anthracite	20.80	11.47	2.78	0.10	8.80	0 10	55.95	132.66
3-7	"	"	19.90	13.84	2.30	0.20	8.40	0.00	55.36	134.18
3-12	"	"	20.90	10.40	2.31	0.20	7.30	0.50	58.39	126.4
3-12	"	"	24.40	9.90	1.10	0.10	5.10	0.40	59.00	122.4
3-2	"	Soft Coal	20.30	14.43	2.28	0.20	8.20	0.00	54.59	137.13
3-3	"	"	22.20	11.58	1.74	0.20	7.40	0.20	56.68	128.70
3-4	"	"	18.40	12.42	2.11	0.20	7.80	0.00	59.17	122.82
3-5	"	"	21.60	12.99	2.78	0.20	6.50	0.00	55.93	141.70
3-6	"	"	19.50	13.21	3.01	0.20	7.70	0.00	56.38	136.37

Composition of Wood Gas made by Nacozari Gas Plant, from Eight Consecutive Analyses, is as follows :—

Date			H	CO	CH_4	$Cn H_{2n}$	CO_2	O	N	B. T. U. at 62° F. and Sea Level
3-14	Mixed Gas	6.05 p.m.	13.50	11.70	2.30	0.60	16.20	0.00	55.20	113.2
3-14	"	9.35 p.m.	18.91	11.00	3.10	0.30	17.90	0.00	48.79	131.5
3-15	"	10.15 a.m.	20.61	14.80	1.67	0.30	14.70	0.00	47.92	134.8
3-15	Water Gas	.....	51.38	10.30	2.38	0.80	20.20	0.00	14.94	233.97
3-15	Mixed Gas	4.40 p.m.	22.31	11.80	3.10	0.40	17.20	0.20	45.19	146.55
3-16	"	11.35 a.m	22.35	14.00	2.45	0.20	15.20	0.00	45.80	144.00
3-16	"	3.40 p.m.	22.35	12.50	3.06	0.30	16.40	0.10	45.29	146.9
3-19	"	11.15 a.m.	19.28	15.50	2.31	0.20	14.40	0.40	47.91	137.59
Average of Mixed Gas Analyses			19.90	13.04	2.57	0.33	16.00	0.10	48.00	136.36
			19.28	15.5	2.3	0.20	14.40	0.40	47.91	137.6

Calorimetric Tests on Wood-Gas from Nacozari Gas Plant.

Date		B. T. U. Actual	B. T. U. at 62° F. and Sea Level	Date		B. T. U. Actual	B. T. U. at 62° F. and Sea Level
3-30	Mixed Gas..	108.8	125.8	4-16	Mixed Gas..	120.8	139.9
4-8	" ..	105.2	122.5	4-16	" ..	118.7	138.1
4-8	" ..	112.34	128.77	4-17	" ..	113.4	129.6
4-8	" ..	110.84	128.14	4-17	" ..	112.0	128.9
4-8	" ..	115.72	134.93	4-17	" ..	112.0	129.5
4-9	" ..	112.4	131.7	4-18	" ..	110.7	128.4
4-9	" ..	111.9	128.1	4-24	" ..	116.5	135.7
4-9	" ..	109.4	126.9	4-30	" ..	115.4	134.2
4-9	" ..	112.2	130.61	4-30	" ..	119.9	140.6
4-10	" ..	113.2	129.1	4-30	" ..	123.9	146.5
4-10	" ..	113.7	130.1	5-8	" ..	104.8	122.4
4-10	" ..	122.9	141.6	5-8	" ..	114.7	136.4
4-11	" ..	108.58	126 86	5-8	" ..	118.3	140.7
4-15	" ..	109.7	128.1	5-9	" ..	115.8	134.8
4-16	" ..	111.8	128 85	5-9	" ..	118.8	139.2

The efficiency of the mixed gases, whether made from wood or coal is substantially the same in the gas-engines. The engines are direct belted to generators, which give continuously, with wood or coal-gas, 48 kilowatts per generator, equal to 70 B.H.P. per engine. The capacity of the engines is reduced, due to the works being at an elevation of 3,500 feet above the level of the sea. A gas as high in hydrogen as the wood-gas would give much trouble from back-firing in the engine. No inconvenience, however, is experienced on that score, which is probably due to the retarding influence of the high percentage of carbonic acid.

I have no doubt whatever that this apparatus and process would be admirably applicable to the conversion of the coarser waste from saw mills; but in using sawdust the grate bars would, as in the Swedish sawdust producer, have to be dispensed with, and in their place probably a deep layer of coke supplied. The combustion of this coke would

PLATE VI.



General view of Concentrating and Smelting Plant of the Moctezuma Copper Co., Nacosari, Sonora, Mexico.
All the power is furnished by Loomis Gas Plant with Gas Engines and Electrical Distribution.

be slow, and therefore it would need to be replaced only every three or four days, when the accumulation of wood ash would necessitate cleaning out one generator and lighting another. It would probably be most advantageous to use a mixture of sawdust and the coarser waste.

The wood used at Nacozari is a green scrub oak, which, however, remains stacked in the yard for six weeks or two months before being burnt. The very green wood does not give a gas of as high calorific composition as wood thus partially dried; and therefore the probability is that sawmill waste would have to be stacked for a time before being gasified. Whether, therefore, the gas be used for steam generation at the mill, or for heating in metallurgical furnaces, or as a source of heat for other purposes, it would seem that the practicability thus afforded of turning the large quantity of waste, which is annually disposed of at considerable loss, into fixed gas, capable of being used at a distance from the mills, should excite some interest among our lumbermen. At Nacozari the quantity of wood-ash, as made, is large enough to warrant us in recovering from them the potash salts, and the same would be true at any mills which might adopt this method of disposing of theie waste.

Mining and Concentration of Corundum in Ontario

By M. F. Fairlie, School of Mining, Kingston.

Although corundum, in a deposit capable of being economically worked, was discovered in Ontario some twenty four years ago, the mineral remained unidentified till the year 1896, when its occurrence in the Township of Carlow, Hastings County, was proven.

During the ensuing two years the corundum-bearing rocks of this district were accurately traced, and conditions of occurrence discovered. The prevailing country rock is gneiss, composed chiefly of hornblende, biotite and felspar, which is cut through by dykes and masses of felspar and mica and in some cases nepheline syenite; these dykes and masses carrying corundum as well as small quantities of magnetite, pyrite, garnet, etc.

The largest deposit of corundum yet discovered in Ontario, and the only deposit which has as yet been economically worked, occurs on the Robillard property, Raglan Township, Renfrew County. In this instance the occurrence is on the southern face of a high hill, at whose base lies a marsh, into which empties a stream running along the western base of the hill. The corundum occurs in a broad dyke of almost pure felspar outcropping at intervals on the face of the hill, which is thickly covered with underbrush. The corundum itself is in the form of hexagonal crystals usually barrel shaped, scattered through the felspar, the crystals varying in size from half an inch to five or six inches in length, and varying widely in color although usually of a brownish and greenish shade. The crystals occur in varying profusion throughout the felspar, being thickly concentrated in one place while a few feet away the felspar will be practically barren; this concentration of the corundum in the felspar apparently follows no definite law. The property was secured by the Canada Corundum Company in 1900, and during the year work was begun in developing the deposit and in constructing an experimental plant for the concentration of the ore and preparation of the raw corundum for market. Since then the process has been gradually improved, and from personal experience in this plant, I shall endeavor to first give a description of the mining of the ore and method of concentration as at present practised, and then discuss the methods in use.

Regarding the mining little need be said, as the operations are exceedingly simple. As yet no sinking or tunnelling has been done either on this or on any other Ontario corundum deposit, a fact which is to be regretted, and the winning of the ore merely consists in stripping the dyke, drilling being done by hand and dynamite being used in blasting. The ore is roughly sorted at the mine and waste rock discarded; the picked ore carrying probably an average of 10 to 15 per cent. corundum, being transported by wagon to the mill, situated three-quarters of a mile away on the creek before mentioned. This method of mining will probably be improved by the installation of a steam breaker plant at the mine and the use of power drills.

The concentrating proposition presented by the ore is the separation of the aluminum oxide with a sp. qr. of about 3.9 from the felspar gangue with sp. qr. of about 2.4 to 2.5 and the elimination of such impurities as magnetite and pyrite as well as mica. Previous to this time the only attempt at concentrating corundum had been made on the North Carolina and Georgia deposits. In the case of the North Carolina deposits the corundum occurred either loose in chlorite and vermiculite scales or enclosed in a gangue of felspar, margarite, etc., or as a constituent of a solid rock. Where the gangue was sufficiently soft it was merely washed in sluice boxes, through which flowed a strong stream of water, carrying away the lighter gangue; where the ore was not adapted to this method it was crushed in breakers and rolls, then stirred in boxes with a strong current of water, thus removing part of the gangue, and was then passed through a machine in which a coarse worm, like a screw conveyor, revolved on a shaft. Most of the gangue was thus cut away by the friction of the corundum grains on each other and was washed out by a current of water. To finally clean the corundum it was placed in a machine called a "muller," a low tub in which two rolls moved round the circumference on the corundum Iron teeth in front of the rolls kept the ore stirred up and a stream of water carried the light gangue away. The methods used in Georgia were on the same principle, depending on the grinding together of the corundum grains to effect a separation of the gangue and corundum. These methods were not adapted to the Ontario ore owing to the hardness of the gangue and the close connection existing between the felspar and corundum; so that any experience gained in the South was of little value in designing a plant for the treatment of Ontario corundum.

For treatment of the ore at the Ontario mine an old saw mill was remodelled, additions made to it, and concentrating machinery with a capacity of about 25 tons of ore per day was installed. For the operation of crusher and rolls, water power is used, a head of 50 feet being available. The creek is dammed above the mill and the water led through a 14-inch pipe for about 100 yards to a five nozzle water wheel of the Cascade type. The wheel is belted up to shafting and from there power is transmitted to the mill by means of wire cable. The rest of machinery of the plant is run by a 25 h.p. high speed engine.

The ore as it comes from the mine, is dumped into ore bins situated at the crushing floor and from there is fed by hand into a No. 2 Gates Gyratory Crusher, with a rated capacity of 12 tons per hour. This rating is, however, far above its actual accomplishment on account of the tenacity and extreme hardness of the corundum, and also the toughness of the felspar which is finely crystalline and devoid of cleavage lines. In crushing, the corundum and felspar do not part readily, and a clean separation cannot be effected unless crushed to at least 12 mesh.

After crushing to pass through a 1½ inch ring, the ore is elevated to a storage bin and is thence fed to a set of 16 × 24 inch belt-driven Gates rolls, and crushed to ½ inch size. The crushing in these rolls, as well as all subsequent crushing, is done wet. The ore is now elevated to a two-compartment Trommel 1 fitted with 4 mm. and 8 mm. punched steel screens, giving three sizes. (1) The 4 mm product passes to Trommel 2. (2) The 8 mm. product passes to a double-compartment Hartz jig fitted with 7 mm. screens, thus giving both heads and also hutch product; the overflow is run off as tailings, although a considerable amount of corundum is here lost owing to the fact that until more finely crushed, the corundum and felspar do not break cleanly and a large piece of felspar attached to a smaller piece of corundum will escape

into the tailings. (3) The oversize from Trommel 1 goes to a double-compartment Hartz jig, whose overflow returns to the rolls. The 4 mm. product from Trommel 1 passes to Trommel 2, which divides it into three sizes. (1) 1.5 mm. product going to a Wilfley concentrating table. (2) 2.5 mm. product going to a double-compartment high speed Gates jig. (3) Oversize going to another double-compartment Gates jig with a slightly longer and slower stroke than latter. The overflow from these jigs is run off as tailings. The hutch product and heads from all the jigs go for recrushing to a set of 30 × 6 inch high speed Colorado rolls, and after crushing are elevated to Trommel 3, which divides into three sizes:

(1) 1 mm. product going to Bartlett table.

(2) 1.5 mm. product going to Wilfley table.

(3) Oversize returning to rolls.

On the Bartlett table a fairly clean corundum-magnetite concentrate is got on the two top shelves; the product from third shelf passes to a Wilfley table which also receives the 1½ mm. product from Trommel 3, and on this table also a concentrate of probably 85 per cent. is recovered. The capacity of one of these tables on corundum ore is about 12 tons per day, but of course depends on regularity of feed, and manipulation. The concentrates from the Bartlett and Wilfley tables are placed on a steam drier, heated by exhaust steam from engine and thoroughly dried, then elevated and passed through an electro-magnet. This first passage through the magnet removes practically all the magnetite from sizes coarser than 24 mesh, but the percentage remaining in finer sizes increases directly as mesh increases in fineness.

The dried ore is now ready for sizing, and is elevated and run onto "splitters," long horizontal frames, fitted with screens and given a reciprocating motion by means of an eccentric. These splitters "split" the corundum into the primary sizes, 90 mesh and finer, 80 mesh, 30 mesh, coarser than 30. Each of these sizes, with the exception of 80 mesh, goes to a separate "grader" working on same principle as "splitter," and there the corundum is graded into sizes 12, 14, 16, 20, 24, 30, 36, 46, 54, 60, 70, 80, 90, 100, 120, 150, 174, 200 mesh. Approximately 50 per cent. of the product is in sizes 12 to 24, 45 per cent. is in sizes 30 to 80 mesh, and 5 per cent. in fines.

In order to get a sufficiently clean product for shipment it is necessary that the sizes from 24 up to 200 mesh be "rewashed" to remove the remaining felspar. Each size is washed separately on a Wilfley table used for this purpose alone, and corundum practically perfectly free from felspar is thus secured; whereas, without sizing, such a result was found to be impossible with this ore. After this rewashing the corundum is dried and again run through the magnet to remove any remaining magnetite. It is then sized again as before and put in 200 lb. sacks ready for market. The sizes from 12 to 24 are entirely freed from felspar and magnetite by one operation, so require no rewashing. Of the other impurities in the ore, the mica causes no trouble and is easily removed on the jigs, while the pyrite, which, however, is almost negligible, remains in the finished product.

To discuss the methods of corundum concentration: The crushing machinery, of whatever kind, necessary for corundum ore, should in the first place be of the very best owing to the extreme hardness of the corundum itself; which, in fact, is only exceeded in this respect by the diamond; and to the felspar also, which, although not as hard as a quartz gangue would be, is more tough. Repairs to crushing machinery used on this ore is a very important item of expense, so that an ordinary jaw breaker of the Blake type would be more profitable than a gyratory of the same rated capacity, owing to the ease, rapidity and low cost of repairs of the former compared with the latter.

Regarding the rolls also, the best are necessary. Manganese steel shells are here used on the roughing rolls, the life of a set being limited to about two months, as it is impossible to prevent uneven wear of the shell face and the forming of flanges on the edges. The shells, however, can be turned down in a lathe and again used. For recrushing the jig products high speed rolls are best adapted, as the object is to produce as small a proportion of slimes and fines as possible. The high speed roll does this admirably, as it is possible for the ore, when once crushed fine enough, to drop away from the coarser, thus escaping the further crushing which results where "free crushing" conditions do not prevail. The Colorado high speed rolls used here are especially adapted for this hard work, owing to the side adjustment by which the free roll can be shifted laterally to effect the even wear of the shell face. Centrifugal rolls, driven by a single belt at a speed of 800 revolutions, were tried here for recrushing concentrates, but owing to the rapid wearing out of the shells, and the wearing out of the bearings from the jar caused by the crushing of such hard material, they were found entirely inadequate for the work.

Regarding the trommels it will be noted that all the material from the roughing rolls passes first over a 4 mm. screen; this of course causes excessive wear on such a screen, and a better arrangement would be a a set of short trommels each fitted with one size of screen and placed in a series beginning with the coarsest and ending with the finest, but the method in use is best suited to this mill as the fall required is not so great.

Hydraulic classification is not employed here and as a result slimes, formed by crushing, escape into the tails from the jigs and tables. Owing to the character of the ore, however, by the proper arrangement of the feed to the rolls, the production of fines can be reduced to a minimum. To save the slimes hydraulic classification would have to be resorted to, with subsequent treatment of the overflow in settling boxes and some form of slime table. Although practically all the product passes over jigs before going to the concentrating tables, it will be noted that no final product is obtained and that both concentrates from the jig bed, and also hutch product from all the jigs, go finally to the concentrating tables. This seems to be open to criticism. From experience with both Bartlett and Wilfley tables on corundum ore I think that they will take 1 mm. and 1.5 mm. material direct from the trommels without previous classification or jigging, and give a fair concentrate. This would necessitate another table for a plant of this size and another set of recrushing rolls, but the expense of jigging would be removed, and loss of corundum in jig tailings obviated. As the jigs are at present run it is necessary in order to prevent loss in tailings, to keep the bed on the second compartment very low and, as a result, felspar gets into the hutch. Of course without the use of jigs, so clean a concentrate might not be obtained on the tables; but when this concentrate is sized and rewashed on Wilfley, as is necessary in any case, no trouble should be found in getting a pure corundum product. The increased crushing necessary, where jigs were not used, would result in an increase of corundum fines, but this increase would be unimportant, as the corundum does not readily form fines.

I have already mentioned the necessity for careful sizing of the table concentrates, and then final concentration of each size separately on a Wilfley table, in order to secure pure corundum; this was proved by experience. In experimenting, the "30 to 80" mesh material, as it came from the "splitters," was run together over a Wilfley table, but practically no further coucentration took place; however, when this was sized on the "graders" into the intermediate sizes 30, 36, 46, 54, 60, 70, 80 mesh and each size run over the concentrator alone a perfect corundum product was obtained.

A machine which may yet have a very important bearing on the economical concentration of corundum, is the Hooper Pneumatic Concentrator, one of which is in operation at this plant, being used only for rewashing the sized material. As its name implies, no water is used, the concentrating being effected by air blast. This is a great advantage

in the work for which it is used here, *i. e.*, reconcentrating the sized product, as it saves the redrying and resizing necessary where the Wilfley is used; and it also gives a magnetite and pyrite concentrate, thus affording an opportunity for removal of the latter impurity. It has also the added advantage of slightly greater speed than is possible on Wilfley, but it has the disadvantage that it cannot treat a finer size of corundum than 100 mesh nor coarser than 24 mesh. A change in design may, however, obviate this difficulty. If this concentrator were used for general work, the crushing would be done dry and the ore carefully sized, as the machine will not work on damp, unsized material.

It might be added that, in the case of corundum occurring in "nepheline" syenite, as is very frequently the case in Ontario, the difficulty in getting a pure product might not be so great, as the corundum breaks very freely from the gangue.

The Old and New Iron Industry Compared.

By JOHN BIRKINBINE, Philadelphia.

The activity prevailing in the iron and steel industry, especially the developments contemplated and in progress in the Dominion of Canada, will probably command attention at the Annual Meetings of the Canadian Mining Institute, and the following is presented as a contribution to such discussion and as a slight recognition of the compliment conferred upon the writer by his election to honorary membership.

The known deposits of iron ore in British Columbia, on the north shores of the Great Lake region, in Central Ontario, in Quebec, New Brunswick, Nova Scotia, Labrador, and in the adjacent islands, including Newfoundland, have invited the prospector and explorer, while facilities offered in the Dominion have suggested the possibility of the ores from some of these being assembled where fuel is cheaply obtainable and markets for the products can be developed. Descriptions of some of these deposits or of works to treat the ores are included in the Institute's transactions and the history of iron manufacture in Canada from the establishment of the St. Maurice forges has been presented by those posted as to details or familiar with local conditions. The development of the iron and steel industry within the United States also forms an equally interesting story, although it covers a lapse of time less than three centuries, and a brief resume of this is offered.

This paper is suggestive rather than historical, hence mere mention will be made of the early effort in the United States where an iron industry was attempted along the Atlantic Coast from 1630 to about 1740, primarily by utilization of bog ores and local brown hematites. The production was not of importance, measured by quantity, and practically all of the plants were either forges, or blast furnaces and forges combined so that the pig metal was cast, and also the wrought material fabricated.

About the middle of the 18th century the distribution of blast furnaces extended over a somewhat greater area and in addition to the brown hematites, magnetic ores were employed, but the ore was either reduced to blooms in Catalan forges or the pig metal was still fabricated in forges after it came from the blast furnace. All of the furnaces and forges up to about 1840, were fed with charcoal and were operated with cold blast.

The control of the iron works was generally directed by the owner, who exercised absolute dominion over a considerable territory. Each plant produced its fuel from wood, cut and carbonized upon property connected with the furnace or adjacent thereto, mined ore from its own or convenient lands, or quarried limestone nearby, making these early iron works self-dependent. In addition to the supply of raw materials, each works maintained its store, smithery, and generally a mill to supply the employees and their families; little money was used, most of the labor being taken out "in trade" at the store or mill. Each aggregation of houses about these iron works, which sheltered the employees and their families as tenants of the owner, was a settlement and independent of others, often reached by long and tedious wagon journeys. The transporting of the material to the furnace or forge and also the product from them was by animal power, first on the backs of mules, or later by large wagons each drawn by a number of animals. These wagons made extended journeys to points of consumption and brought back, with the necessary supplies required for the community, news from the outside world. The owner or "iron master" was practically "monarch of all he surveyed," owning the lands, farm, furnace, forge, mill, store, tenements, not infrequently the church and school house, or at least the ground they occupied, and while slavery prevailed in a portion of the United States, some were also owners of many of the employees. On his arm, feed for his horses and cattle and grain for his mill were raised. If he elected to serve, he was Justice of the Peace and Post-Master—otherwise trusty subordinates were named at his dictation. He was the political, and in some instances, the religious guide for his people, but often the manager did not intrude upon religious duties as upon political privileges, giving to his employees and their families unlimited proxies to represent him at the revival services at which a number "got religion" each year—at least a supply believed to be sufficient until the frogs croaked in the spring, after which it was often accepted as more or less of an incumbrance.

Long credits allowed on the sales of products or claimed on the purchase of materials, made the owner or manager of one of these older plants also a banker, whose fiscal work was mainly confined to short seasons recurring once or twice every year.

As to the blast furnaces, a massive stone stack about 30 feet high and about 30 feet square at the base enclosed the refractory lining whose greatest diameter seldom exceeded 9 feet. This furnace, operated by a water wheel propelling pistons in wooden cylinders or moved ponderous bellows, was kept in operation from 8 to 10 months of each year, producing an average of about 100 tons of pig iron per month, but was then blown out for re-lining. During this season of inactivity the miners and furnace men not needed in repair work were sent into the forest to chop wood for the next season's coaling or aided in stripping the overlay from ore banks. The raw materials for the furnace were produced by hand labor, hauled by wagons to the charging floor on the hillside or bank at the same height as the furnace top, and fed into the tunnel head by barrows, baskets or boxes. The metal produced and the resulting cinder were also handled by manual labor, and the labor item was prominent in the cost of metal produced.

This briefly details conditions prevailing up to about the year 1840.

With the introduction of the hot blast, nearly contemporaneously with the application of mineral fuel in America, and closely following the construction of canals, and later the development of railroads, it became possible to utilize as avenues of transportation the canals and railroads. Some blast furnaces were moved from the immediate vicinity of the ore or fuel supply and the tendency was to locate new plants about business centres. The size of the furnace was increased and improvements in equipment introduced, but up to about 1880, there were a number of cold blast furnaces constructed and operated practically as described above. There are several cold blast charcoal furnaces still active in the United States, whose equipment, however, has been improved and labor saving introduced to a limited extent. These furnaces produce special grades of metal which command prices

permitting of following the methods indicated, but the demand for quantity is slight.

With the proportions of the furnaces increased and improved steam machinery to operate them, the product was augmented and from a score of tons per week the output gradually increased to as much as 100 tons per week. About 1850, products from a furnace of 200 tons per week were occasionally reached as more powerful equipment was supplied. The forges being separated from the blast furnaces and rolling mills substituted, more of the product of the furnaces was carried to distant works where it was manipulated and fabricated into commercial forms.

In the next two decades interest in the chemistry of the blast furnace was excited, and about 1876 the technical side of iron smelting received liberal attention, the iron masters of the United States profiting largely from the Centennial Exposition in Philadelphia, where experts in all branches of iron metallurgy came together from various parts of the world and discussed the problems which each had to meet with in his own locality. In the meantime the manufacture of steel by the pneumatic, or what is generally known as the Bessemer process, was advancing and the requirements for metal became greater, so that the product per furnace and the total for the United States was materially increased. The machinery to operate the blast furnace was constantly improved and this improvement extended to the mills where the pig metal was either puddled or converted, requiring a large output, to meet which the capacities of furnaces were augmented.

Up to 1870 the majority of the iron plants had been operated by individuals or partnerships, but incorporated companies entered the field, thus permitting of enlarged development with greater capital and division of responsibility. The fire-brick hot blast stoves were introduced about the time of the Centennial Exposition in Philadelphia, aiding to augment the output and decrease the fuel consumption per ton of iron, while chemical researches demonstrated the increased value of rich ores and the demands of the Bessemer plants made necessary the selection of many ores low in phosphorous.

About the year 1880 a daily output of an individual furnace which reached 100 tons was phenomenal. Since that time general advances in all lines technical, metallurgical and mechanical have been pronounced and a furnace which two decades ago produced 100 tons per day is not now notable if it exceeds 300 tons, although the dimensions of the stack may be the same. Various experiments were made to develop the blast furnace in height, in diameter of bosh and in diameter of crucible, but there has been no greatly augmented height nor has the diameter of bosh of many of the furnaces been extended much more than those of the largest furnaces of twenty years ago, although the record of some individual plants have reached 800 tons in one day, or as much as an up-to-date furnace would produce in a year prior to 1840. In the larger plants which are now in operation, equipped with powerful steam engines, ample boiler capacity, sufficient hot blast stoves, appliances for handling the raw materials and also the product, an average exceeding 500 tons a day is not unusual for a considerable period. A blast furnace plant designed to produce 1,200 tons daily, may at present consist of two or three furnaces, and the question of preference is an open one. It is probable that, all things considered, better results will be obtained from dividing this quantity among three units than among two, that is, having three furnaces each producing about 400 tons per day rather two with a capacity of 600 tons per day. This, however, is not the time to discuss this detail.

A development such as that indicated in the foregoing hurried recital could not have been spasmodic but was gradual and within a half century marked advances have been fairly persistent, although some developments were quite sudden. Conscientious and careful study by engineers, mechanics, chemists and superintendents to obtain a large output and secure the greatest economy of operation has resulted in achieving the record described.

Under the older method detailed, it would be impracticable to assemble the large amounts of raw materials required, or to handle these, and the present product at one of our modern blast furnace plants. The number of men and animals necessary would interfere with each other, and the available space around a furnace plant would be insufficient for the work, if it were done according to the older and more expensive methods.

To obtain the amount of pig iron credited to the United States in 1901 (15,878,354 gross tons) it has been necessary to develop enormous mines, both of ore and coal, to equip them with the best of machinery for winning and handling the material, to build thousands of coke ovens, to construct hundreds of miles of railroads supplied with powerful locomotives and capacious cars in which the materials can be cheaply transported and from which they can be readily discharged; to erect enormous shipping docks where the ore is conveniently and economically handled into vessels and to prepare also extensive docks where the ore can be taken from vessels and transported rapidly and at small cost placed on stock piles or railroad cars.

These features have also resulted in the establishment of an important maritime trade on the Great Lakes, where powerful modern vessels of large capacity have been supplied in great number.

When the raw material reaches the modern blast furnace, it is received and distributed by means of mechanical appliances and bins costing large amounts of money, the tendency being to eliminate, as far as possible, in mining, in handling, in transportation and at the furnace, manual labor, by substituting mechanical appliances. The pack mule first gave place to the wagon and team, the wagon and team were supplanted by canal boats and these by railroad cars carrying five tons of material. Now cars holding 50 tons drawn by ponderous locomotives move the ore which is dug from mines by steam shovels or won by the use of air drills, supplemented by electrical or air motors. It is discharged by gravity from cars with drop bottoms, which either carry the material directly to the consumer or to docks where the material drops into pockets and from these is shot into vessels. Great "grabs" at the terminal docks lift this ore from the holds of vessels and mechanical appliances convey it to stock piles and cars, these latter transporting the ore to the bins or stock piles at the blast furnaces where other mechanical appliances move it or lift it to the furnace top, and much of the ore now used is not touched by hand from its native bed until it enters the throat of the blast furnace. This ore obtained from mines several hundred, and even exceeding 1,000 miles distant from the blast furnaces, is delivered to them at no greater cost than some of the near by ores fed to the older furnaces which were won entirely by manual labor. Similarly the advancements in coal mining have been in the use of compressed air and electricity or continuous rope haulages with cars which convey the fuel to the ovens into which it is automatically dumped. Some ovens are built so as to utilize a portion of the non-condensible gases, the condensible being converted into commercial products, and in addition to obtaining value from these it is possible in by-product ovens to utilize some coals which otherwise would be unfit for coking by reason of their low volatile contents. The metal, after it is smelted in the blast furnace, instead of being tapped as was formerly the case, and handled by manual labor, now runs into ladles carried on trucks which deliver it to mechanical casting machines, or it is charged direct into mixers or converters at the steel plant. It is at these plants that mechanical ingenuity and great economy in labor and material have

reached a most commendable result. The converted metal cast into ingots of weights up to 5 tons (and in the construction of ordinance or armor plate of 20 tons or more) passes to hydraulic presses or to blooming mills and in many cases a practically continuous mill permits of the finished product being produced without the metal reaching a temperature below that which can be readily raised by temporary "wash" heats. The finished product from a number of these mills, whether it be rail, bar, shape or plate, is now produced and marketed at prices no greater than the old charcoal furnaces received for pig iron.

The perfection of the mechanical equipment is marvelous. The molten metal brought in ladle cars each holding 15 or 20 tons, is discharged into a tilting mixer with a capacity of 300 tons. This mixer feeds the converters or open hearth furnaces from which ingots are cast and quickly conveyed to soaking pits or gas furnaces. Powerful cranes place the ingots on the feed tables of blooming trains to be rolled and sheared to billets and these pass to other trains so that in a brief interval the finished rail, shape, bar or plate is produced.

It is probable that in a modern mill ten tons of finished product are obtained by the employment of no greater number of workers than were necessary in crudely fabricating one ton a half century ago.

With the increase of quantity and the improvements for handling and using the raw materials, augmented capital became necessary to develop and exploit large mines, to build railroads, to construct vessels with the necessary shipping and receiving docks, to erect furnaces, converting plants and mills of large capacity and equip them with the machinery and appurtenances requisite to produce the quantity of material desired at the lowest practicable cost. As this augmentation became general, private or partnership control was, except in relatively few instances, supplanted by corporate ownership. At present corporate control is so combined as to encourage centralization of interest and management, capital of some of the important iron and steel companies reaching figures scarcely appreciable to the average business man. When the stock of companies is rated by hundreds of millions, and in one case exceeds one thousand million dollars, the figures are hardly understood by most of those engaged in commercial enterprises. This centralization and consolidation is being watched with great interest; that it has merit can be demonstrated from a number of points of view; that there is danger in it is apparent from different aspects. But few combinations have been possible except by associating with successful and good paying enterprises, others which were at least doubtful and whose location, equipment or other causes, handicapped them in the race for pre-eminence. The stronger will have to carry the weak, and there may be times when this burden will be troublesome. A great business can undoubtedly earn great profits, but enormous capital also means proportionate interest charges which must be met.

While we may consider ourselves in an era of consolidation, the entire iron and steel business may not be so classed. The bulk of the iron and steel trade of the United States is undoubtedly controlled by a few corporations, but there are a number of relatively modest enterprises which are, and under proper management, will continue to be successful. Although the prices of products may be generally dictated by the stronger, the relatively weaker will prove important factors not only to the supply of the general public, but will be used to a greater or less extent to supplement deficiencies of the larger enterprises, and even a small producer with a moderate amount of product to dispose of may demoralize a market apparently strongly sustained.

In some of the later developments which have been made or are in contemplation, there is apparent neglect of the essential feature of convenience to a remunerative market. The industries which have been most profitable have developed from smaller ones to great ones. There are but few instances where large plants have become successful unless these have resulted either from an earlier development or of a combination of neighboring interests. Many of the modern plants occupy the sites of ancient industries, are successors of these, or are located in districts in which for a term of years labor has been educated and market facilities secured.

The danger which seems to threaten the iron and steel industry is the enthusiasm with which great projects are launched and for which great promises are made. With no desire to question the propriety of a number of the important projects contemplated or in course of erection, there is, to the careful observer, an apparent neglect in some instances of the question of practically continuous remunerative markets.

The iron and steel industry of the United States is no longer in its infancy, it has grown to maturity and individual plants now produce more metal in a year than the entire United States supplied less than half a century ago. Nor is the industry dependent upon local supplies of raw material; railroads with improved locomotives, large cars, substantial road-beds and bridges and advances in vessel construction both as to power and capacity, the facilities of shipping and receiving docks where these are necessary, the equipment of important mines and the selection and handling of the material mined, all combine to admit of assembling raw materials from long distances or of shipping manufactured products to far away consumers. The mechanical appliances and methods introduced at the blast furnace, the converter, and the mill, make possible enormous outputs at small cost for labor, fuel and administration.

The substitution of mechanical appliances has materially reduced the requirements for skilled labor, while the transportation problem permits of the assembling of the raw materials and distribution of the product.

The modern blast furnace stack, although three times as high, occupies no more ground space than its ancient prototype, and the equipment of 4,000 H. P. boilers, cross compound blowing engines, supplying 1,000 cubic feet per second, at pressures of 20 pounds or more, delivered through 10 or more tuyeres into the blast furnaces at temperatures of 1,200 degrees Fahr. seem strange developments from the weary water wheel forcing from its bellows or tubs a weak blast through a single open tuyere. The 3,000,000 or 4,000,000 gallons of water demanded for steam and cooling purposes by a modern blast furnace would have gone far, under a liberal head, to have been the motive force operating the older furnaces.

The advances in quantity of product, in the control of its character, in the low consumption of fuel, have all been made possible by a study of the chemistry of the blast furnace, which exposes to the student the secrets of the smelting process, and the modern furnace is as much a tribute to the work of the chemist as it is an example of the highest skill of the mechanical engineer. It is not alone to the blast furnace that such credit is due, for the Bessemer steel converter with its startling reactions, the massive open hearth steel furnaces, the handling of large ingots, the rapid passing of these into commercial shapes, equally pay tribute to the genius of the metallurgist and the mechanic.

The Centre Star is on the shipping list again, and the output has been at the rate of four thirty-ton cars daily since operations were resumed. It is regarded as probable that this will be increased at an early date to ten cars daily or thereabouts. The management of the mine is devoting its attention principally to the development of the deep workings, and good progress is being made in the shaft and the horizontal workings at the 700-foot level recently got under way.

The Harris System of Pumping by Compressed Air, as Applied at the Deloro Mine.

By J. P. KIRKGAARD, Deloro, Ont.

The raising of *water* from mine workings is often a serious problem, and always a heavy cost on mining, even under favourable conditions; this subject, therefore, is a matter deserving of serious consideration.

At the Deloro Mines, Hastings County, Ontario, a shaft was being sunk which had an inflow of water amounting form 400,000 to 500,000 gallons per 24 hours. To deal with this amount of water by the then existant plant of "direct-acting steam pumps" was both slow and costly.

The greater part of this water flowed into the mine through and along the footwall, at the south end of the ore chute, and from thence to the lower workings, where the shaft was to be sunk.

The writer conceived the idea of impounding most of this water, making a permanent pumping station on the third level, and thus practically leaving the lower workings dry. An old shaft at the south end of the ore chute, being admirably situated to suit this purpose, was selected.

The bottom of this old shaft was 47 feet below the second level and full of water, and 35 feet above the third level, which latter had already been driven under and past this shaft.

The work preparatory to the installation of this pumping system was as follows:—

A chamber 30 x 15 x 12 feet was blasted out on the third level immediately under the bottom of the old shaft, and all necessary preparations made for constructing a dam to prevent the water from flowing into the third level. This being done an upraise was made to the bottom of the old shaft, thus unwatering the shaft.

While this work was in progress investigations were made of the several types and varieties of pumping engines. The direct-acting pump was out of the question. Plunger pumps driven by compound-condensing engines seemed the best in this line of pumps, but the situation was such that, should anything happen to the pumps or engine, they would be drowned before repairs could be effected.

The next thing presenting itself as suitable was the "Harris" system of lifting water by direct air pressure.

Not only did this system promise great economy over previous installations, but its construction was such that no machinery was required in the mine, other than two tanks and some pipes connecting them with the machinery on surface; and with this system there could be no drowning, no matter what happened to the surface equipment.

The objections against its adoption were these, viz., its greater first cost compared to other systems, and secondly it was an untried system as applied to a comparatively high lift mining installation. However, against these, its simplicity so appealed to the writer that it was finally adopted.

The two tanks, 4′ x 20′, were placed in the "sump" or "chamber" on the third level, the pipes connected to surface and the dam built.

The reservoir thus made, (that is the chamber at the bottom of the shaft 30′ x 15′ x 12′, and the shaft itself, being 82 feet below the second level, and 9′ x 15′ in cross section) altogether gave a storage capacity of 130,000 gallons approximately, thus permitting the engines at surface, if so desired, a period of from 6 to 7 hours rest, without any fear of the water finding its way to the lower workings.

This arrangement has proved very satisfactory and has been a strong factor in reducing the cost of operations, not only in shaft sinking, but also in stoping; these places now being dry, comparatively speaking.

It had also reduced the cost of raising water from 25 to 30% on former cost—part of the economy being in fuel, but mainly in labor and repairs.

Formerly it was necessary to have a pump man constantly attending the pumps; now this service is entirely dispensed with. It will be apparent from what has been said, that this system is only applicable as a "stationary pump," but as such, it is, in the writer's opinion, very satisfactory.

The "Harris" system of air-lift, is composed of two tanks in the mine, which are connected by two air pipes to an automatic switch located in the engine-house at surface, the switch in turn, being connected with an air compressor.

The principle of the system is simplicity itself, although not easy of explanation.

A "cross compound" "steam and air" of the Rand type, class B, compressor is placed at a suitable location at the surface, and two tanks, 4′ x 20′ each, are placed in the mine—the air compressor and tanks are connected by two air pipes, and between the air compressor and the tanks at a suitable point near the compressor a switch is located.

This switch serves the purposes of changing the inflowing air from one tank to the other at regular intervals; these intervals are termed "cycles."

The duration of the cycle may be varied from 2½ to 6 minutes, to conform to the amount of the water to be raised; these variations are governed through the amount of air forced into the system.

If there is only a limited amount of water to be raised, (and there is no object in maintaining a constant supply) provided that the sump, or reservoir is of sufficient capacity, the engine may be stopped for a time and again started by simply turning steam on the compressor, the switch at once resuming its functions, no attention being required at the tanks in the mine.

As regards the air, the system is "closed" or return pipe system, *i.e.*, the same air is used over and over again, returning to the compressor at the end of each cycle for compression, ranging in pressure from that required to do the work, to that which equals the pressure due to the head of water around and above the tanks.

The greater the head above the tanks the greater the economy.

In this feature is the chief economy. The tanks are so connected that they receive air and water alternately, when one receives air and delivers water, the other receives water and delivers air.

It will thus be seen that the air is not brought up to working pressure from the atmospheric pressure, as would be the case in the ordinary air compression.

Attention should be drawn to the fact that the only moving parts in the mine are the inlet and outlet valves at the tanks.

These valves only move once for each cycle, and as near as can be ascertained by listening to them, they open quickly but close gradually, hence the wear is slight. In this case they have never caused any trouble.

In the particular plant under review 96 pounds air pressure is required to force the water through an 8-inch pipe to the mill tank, a vertical lift of 208 feet. The "lift" is kept running steadily night and day in order to supply the requisite water for mill purposes, also for condensation purposes in the compressor house for the condenser of the air lift, and also another pertaining to a 20-drill compressor.

As before stated, the air is forced into the system at 96 pounds pressure, and after the completion of the cycle it returns through the switch into the low pressure air cylinder at a pressure of 65 pounds, immediately after switching, and gradually decreases in pressure through

the cycle to zero, or the pressure of the atmosphere: on reaching this point and the compressor still running and having no other source of supply, (it should be noted that there is a small loss of air through leakage and the working of the switch, as this latter is exhausted into the atmosphere, this loss is made up by a supply of air through a small check valve on a 3/8" pipe, fixed to the low pressure inflow pipe) it follows, therefore, that all the air in the system is extracted, and finally a partial vacuum is created within the tank and pipe line of that side of the system; this vacuum continues to increase until it reaches a point where the atmospheric pressure on the surface of the water overcomes the weight of the inlet valve on the suction pipe connected to the tank, and the water rushes in filling the tank. The vacuum will vary with the height of the water; if below the tank, switching will take place at about 11 inches, if above the tank at 4 to 5 inches or less.

The switch in general appearance resembles a direct acting steam pump, having what corresponds to both steam and water ends. At what would be the steam end, there is a vertical cylinder serving the purpose of the valve, in this works a piston. The space above the piston is directly connected with the air inlet of the compressor, but the space under this piston is open to the atmosphere; it therefore follows that as the low pressure cylinder exhausts the air out of the tank and the pipe connecting it with the switch, creating a vacuum, a vacuum is necessarily thus produced above the little piston; when this point is reached, the atmospheric pressure pushes the piston upwards and this in turn, being suitably connected with a rotary valve on a 1/4 inch pipe connected with the high pressure air pipe, opens this valve, admitting the air which acts upon another piston similar to the steam piston in an ordinary pump. This latter piston is directly connected with a plunger, corresponding to the water-end of a pump, but this latter acts as a valve, opening or closing the passages leading to the pipes connecting compressor and tanks with the switch.

The drawings that accompany this brief description give a general view of the arrangement of the "Harris System of Air Lift" as applied to the raising of water at the Deloro Mine.

Fig. 1 is a plan; Fig. 2, a section; Fig. 3, an elevation of the tanks and dam; Fig. 4, an elevation showing the position of the tanks in the mine.

Referring to the drawings, *'a* is a cross-compound steam and air Rand drill compressor, type B, steam, 10-16-16, air, 14-8-16; *a'* is a condenser; *'b* is the switch located in the engine room; *c c'* are 3" air pipes leading from compressor to switch, and from switch to tanks, in the mine; *d d'* are the tanks, each 4' x 20' with an approximate capacity of 1,800 gallons each; *e e'* are the suction pipes; *f f'* the valves on the delivery pipes; f^2 the 8" delivery pipe; this, as also the air pipes, *c c'* are securely clamped between timbers, at intervals up through the shaft, and from the collar of the shaft are laid together until they reach the compressor building, here the air pipes are connected with the switch, while the water pipe is secured under the eave of the house, running the full length of the building, 75 feet, and from thence up the hill on trestles, until it reaches the mill at the level of the ore floor, a total vertical height of 65 feet, above the collar of the shaft; here the pipe empties into a tank, *g*, 6 feet diameter, by 8 feet deep, this tank is in turn connected with another tank, *g'*, at the opposite corner of the mill, these are the supply tanks for the mill; *h* is an 8" over-flow pipe connected through the bottom of the tank, *g*, and leading back to the circulating tank, *i*, in the compressor building.

This was done to obviate any waste of water, which might otherwise occur if the mill at any time needed less water than the regular supply.

On the delivery pipe, *f'*, at f^2 a 6" branch is fixed, leading to the circulating tank *i;* on this 6" pipe is a valve, f^3, for the purpose of regulating the amount of water needed for the compressor condensers.

For about four to six months in the year all the water raised by the air-lift from the mine is needed at the mill, and during this time the condensers, as also the boilers at the compressor, are supplied by an auxiliary pump located on the river; (*j* is a 20-drill cross-compound steam, single acting air, Rand compressor, furnishing air for all underground work, *j'* the condenser); *l* a battery of three, 100 h.p. each, return tubular boilers.

Fig. 4 shows the position of the tanks in the mine; it will be noticed that these are located at the bottom of a shaft ending on the third level. As already explained, nearly all the water of the mine is confined to this place, the fourth level is almost dry, as is also a winze lately sunk to the fifth level, it is also pointed out that work is being pushed to pass under the bottom of the water shaft, leaving 50 feet of the ore in place.

When this air-lift was put in, it was thought quite probable that the water would break through to the fourth level, it was therefore specified that the lift should be capable of lifting 500,000 U.S. gallons per 24 hours from the fourth level, this would add about 70 feet more to the vertical lift. The makers of the plant have given a guarantee that the plant will perform the above duty, should it be necessary to move the tanks down.*

The writer would like to give more detailed data covering the efficiency of the plant, but owing to the fact that the steam used for the lift is drawn from the same boilers that are supplying the larger compressor, and this latter running constantly, there has been no opportunity to make a test other than a series of "cards" taken at intervals of 15 seconds, throughout the cycles, both from the steam and air cylinders.

These cards are very interesting, showing the variation throughout the whole cycle—there are no two cards alike, but the very fact of this variation makes them of little value—no information of value can be deducted from them.

A table showing these variations is hereto attached.

INDICATOR CARDS, TAKEN JUNE 8TH, 1901.

HARRIS AIR-LIFT CROSS-COMPOUND AIR COMPRESSOR ENGINES.

No. Card.	Time in Cycle.	Gauge reading H P Steam.	Gauge reading L P Steam.	Gauge reading H P Air.	Gauge reading L P Air.	Revolutions per minute.	End of Cylinder.	Card taken by	Remarks.
1	Start switch.	90	25	110	20	124	Both.	Swallow	
2	15 seconds.	90	28	105	110	120	"	and	
3	30 "	90	30	110	105	140	"	Donaldson	
4	45 "	90	30	95	95	148	"	"	
5	1 minute.	89	30	95	80	120	"	"	
6	1 "	90	31	93	80	144	"	"	
7	1¼ "	89	30	93	60	144	"	"	
8	1¼ "	90	30	92	75	120	"	"	
9	1½ "	90	28	91	55	148	"	"	
10	1½ "	90	28	92	45	144	"	"	
11	1½ "	90	27	90	40	148	"	"	
12	1¾ "	90	26	92	45	128	"	"	
13	1¾ "	91	25	91	42	132	"	"	
14	2 "	89	25	91	40	124	"	"	
15	2¼ "	89	22	91	34	148	"	"	
16	2¼ "	90	23	92	35	124	"	"	
17	2½ "	89	23	90	30	148	"	"	
18	2½ "	91	23	91	35	136	"	"	
19	2½ "	90	22	92	33	140	"	"	
20	2¾ "	89	22	92	30	140	"	"	
21	3 "	90	22	91	32	144	"	"	
22	3¼ "	91	22	91	30	136	"	"	
23	End of Cycle	90	21	92	30	132	"	"	

*This plant has been in operation continuously for over a year, raising from 300,000 gl., the minimum, to 650,000 gl., the maximum, per 24 hours.

COMPOSITE CARDS.

No. Cards.	Time from.	Steam. H P	Steam. L P	Air. H P	Air. L P	Rev.	End of Cylinder.	Remarks.
24	0 to 30 sec.	90	20	110	20	140	Crank	High and low pressure cylinders.
		90	30	90	100	140		
25	1½ min. to 2 min.	90	28	92	50	131		
		90	23	92	35	131		
26	2½ min. to 3 min.	90	22	92	30	127		*Composite Card Explained.*— Pencil kept in contact with card during the 30 seconds
		90	22	92	30	127		
27	0 to ½ min.	90	20	110	20	132	Head	
		90	30	100	100	132		
28	1½ min. to 2 min.	90	27	93	50	143		
		90	23	92	35	143		
29	2½ min. to 3 min.	90	22	92	34	134		
		90	22	92	30	134		

AIR CYLINDERS.

30	Switch .	90	20	60	20	136
31	½ min.	90	30	100	105	136
32	1 "	90	31	90	82	148
33	1½ "	90	29	93	60	140
34	2 "	90	25	92	40	152
35	2½ "	90	22	92	35	144
36	3 "	90	22	92	32	120
37	3½ "	90	21	92	30	142

Electrolytic Production of Metals, with Special Reference to Copper and Nickel.

By WM. KOEHLER, Cleveland, Ohio.

In considering this subject, we enter a field made attractive by the successful experiments of painstaking, original investigators, but hedged about with patents obtained by persons who seek to appropriate the results of these experiments which they had neither the patience nor the wisdom to make. We shall find that electro-metallurgy is based on facts known to generations earlier than our own, and by their age the common property of every scientist of to-day, and that the principles involved are so much matters of general knowledge that they are not the special properties of any man or association, that all are free to use them, and that any process, by whatever name it is known, is protected by patents only to the extent in which it is a combination of these well known principles with some patentable invention.

Electro-metallurgy, or, in other words, the electro deposition of metals from solutions, as at present practised, is not to be confounded with the production of metals by means of heat generated, and the electrolytic action dependent upon the reduction, in an electric furnace. It is more than that, and is naturally divisible into two branches: first, the electrolytic refining of crude metals, and, second, the direct production of metals from solution.

Before entering directly upon the subject under discussion, it may be well to give a few moments to electrolysis in general. By electrolysis we mean those chemical reactions which take place when a suitable electric current passes through a chemical combination, which is technically termed an electrolyte. In producing electrolysis, conductors of two grades or classes are necessary. Conductors of the first class are wires or sheets of conducting material, such as are used in the mechanical arts, their object being simply the conveying of the electric current from a point of higher to a point of lower potential difference. A conductor of the second class is always a chemical combination, existing either in solution or in a state of fusion. In electrolysis, conductors of the first class work in pairs. The electric current is not complete when a conductor of the first class enters a conductor of the second class, and to complete the circuit another conductor of the first class must also enter the conductor of the second class, usually at a point opposite that at which the first entered. This pair of conductors of the first class, when in contact with the electrolyte or conductor of the second class are known technically as electrodes, and it is virtually at these points of contact that electrolysis manifests itself. The electrodes are distinguished with relation to the direction of the electric current, as the anode and cathode respectively, the current entering the electrolyte at the anode and leaving it at the cathode. On account of the potential difference produced by the electric current at the electrodes, substantially different masses of the electrolyte (directly proportional to the quantity of current passing) are set in motion. These moving masses, composing the electrolyte, are termed ions, and, for further distinction, those moving toward the anode are called anions; those moving toward the cathode, cathions. At the electrodes proper, in an electrolyte, the ions undergo a chemical change, and this change is known as electrolysis.

The results of this change, according to conditions under which electrolysis takes place, can become of a very complex nature. Under primary conditions the results are comparatively simple. For example, the electrolysis of copper sulphate or sodic chloride solution produces in the first case copper, sulphuric anhydride and oxygen, while, in the second case, sodium (or sodium hydroxide and hydrogen,) and chlorine gas are produced according to the following equation:—

$$Cu\,S\,O_4 \text{ gives } Cu + S\,O_4$$
$$S\,O_4 + H_2O = H_2\,S\,O_4 + O.$$

$$Na\,Cl \text{ gives } Na + Cl$$
$$Na + H_2O = Na\,O\,H + H.$$

A given quantity of the electric current passing through different electrolytes will always set free the same number of valences or transfer them into different combinations. This can most readily be shown by allowing the same current to successively pass through different electrolytes. Results are shown in the following table:—

	Electrolyte	Electrodes	Cathions liberated	Compared to 1 milligram Hydrogen	Atomic Weight	Error
1.	Dilute Sulphuric Acid 1 to 12 $H_2\,S\,O_4$	+ Platinum — Platinum	6.002 mg. Hydrogen	1 mg. Hydrogen	Hydrogen 1	
2.	Potassium Silver Cyanide $KAg\,Cy_2$	+ Silver — Platinum	650 mg. Silver	$\frac{650}{6.002}$ = 108.2 mg. Silver	Silver 107.6	+ 0, 6%
3.	Cuprious Chloride $Cu_2\,Cl_2$	+ Copper — Platinum or Carbon	380 mg. Copper	$\frac{380}{6.002}$ = 63.6 mg. Copper	Copper 63.3	+ 0, 4%
4.	Cupric Chloride $Cu\,Cl_2$	+ Copper — Platinum Carbon	Reduction of 190 mg. Copper	$\frac{190}{6.002}$ = 31.8 mg. Copper	Copper 63.3	+ 0, 4%
5.	Copper Sulphate $Cu\,SO_4$	+ Copper — Platinum	190 mg. Copper.	$\frac{190}{6.002}$ = 31.8 mg. Copper	Copper 63.3	0, 4%
6.	Stannic Chloride $Sn.\,Cl_4$	+ Platinum or Tin — Platinum or Carbon	170 mg. Tin.	$\frac{170}{6.002}$ = 28.3 mg. Tin.	Tin 117.8	— 4 %

The figures, representing the quantities of cathions liberated, give when compared to one unit weight of hydrogen, the amount of metal represented by one of their valences, while a single valence represents its atomic weight. In the solutions 2 and 4, the silver and copper atoms monivalent, in 3 and 5 the copper atoms are bivalent, while in 6 the tin atoms are quadrivalent.

From the foregoing it will also be seen that the quantity of cathions or anions liberated are proportional to the strength of the current and the time through which it is acting. According to researches of F. and W. Kohlrausch, 0.3281 mg. copper are liberated from the solution of an oxide salt of copper by one coulomb.

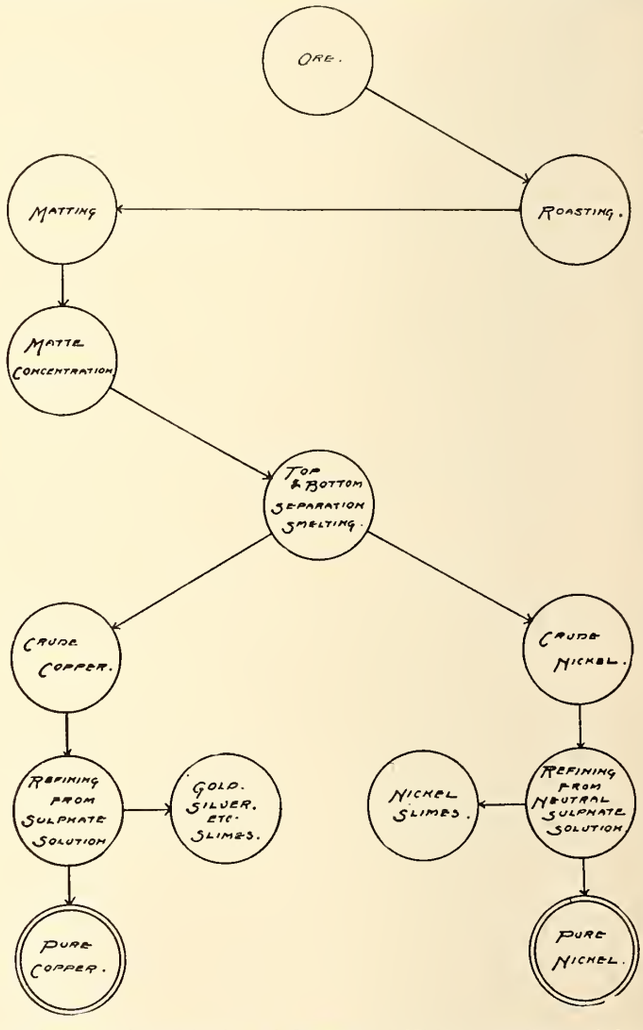
0,6578 mgs. of Copper from cuprous salt.
0,3050 mgs. of Nickel from nickel oxide solution.
0,2394 mgs. of Sodium from salt solution.
0,3682 mgs. of Chlorine from chloride solution.

This list can easily be extended and the values of all elements calculated. The results are known as the electro chemical equivalents. A coulomb being an ampere second, and knowing the potential difference necessary to overcome polarization and bring about dissociation of an electrolyte, the power necessary to deposit a certain quantity of metal from an electrolyte can easily be calculcated. For example, estimating a horse power at 730 watts, or volt amperes, and figuring the potential difference of an electrolyte at one volt, a horse power will contain 730 available amperes. From the above we have the deposition of 0.3289 mg. copper through one coulomb, which, in one hour would be (0.3289 mg. x 3600 seconds) 1.18 grms. copper per hour. 1.18 x 730 equals 861 grms. per hour per horse power, or 20 kilos, about 44 pounds, per horse power day.

As the subject of this paper is electrolytic production of metals, the methods by which matte and crude metal are obtained can only be briefly discussed, For their production various metallurgical operations are resorted to. The ores are subjected to roasting and smelting operations, thereby increasing the metallic values of the products and eliminating some impurities,. When the metal content is sufficiently high they are subjected to what is known as the Bartlett-Thompson separation smelting, by this means producing crude copper and nickel. The crude metals are then electrolytically deposited in general from sulphate or chloride solutions on pure metallic cathodes. (Process by Titus Ulke.)

In the production of copper and nickel, we will first take up the subject of refining. For this purpose a high grade matte, or, better still, crude metal of about 95 per cent. fineness is necessary. The possibility of refining copper by this means was made known by Cruikshanks' researches, dating back to 1800. Of greater importance to refining in general is the process patented by Elkington in February, 1870. This process is the basis of all refining processes in present use, and the inventor claims the recovery of copper, together with the separation of other metals associated therewith. To this end copper ores undergo smelting operations until crude metal is obtained, which is then cast into plates. With the aid of electric current, these are dissolved in a suitable electrolyte and the copper deposited upon other plates. The precious metals contained in the crude metal fall during electrolysis to the bottom of the electrolytic vats. The inventor prefers working ores which contain sufficient silver to effect the good qualities of a pure copper. The impure, or blister copper, is tapped from the melting furnace into cast iron molds, about 600 mm. long, 200 mm. wide, and 25 mm. thick. In one end of such a plate a large and heavy T shaped headpiece of copper is cast into the same. The object of the T shaped headpiece is to provide means for the suspension of the plate and at the same time secure electrical contact. These plates are then suspended, together with the cathode plate, in earthenware vessels arranged in terrace form. This terracing is to facilitate the circulation of the electrolyte, which is a solution of copper sulphate, containing a small amount of free sulphuric acid. The vessels, or electrolytic baths, are connected with each other by lead pipes. The solution from the lowest vessel flows into a sump, from which it is pumped to the vessel at the head of the system, and is again allowed to circulate through the system. The variations of this process and the manner in which the refining of metals is now carried on, are wholly mechanical, and in no way is the original process changed or new principles introduced, although there are innumerable improvement patents in existence. The pioneers in the work of developing the electrolytic refining of copper are Siemens and Halske, of Berlin, through whose efforts the success of the process has been largely secured.

It may here be noted that the method described in the treatment of copper is applicable to the production of other metals: gold, silver, lead, zinc, nickel, etc. The Wallace Farmer patents, a description of which will be given later, have special application to this extension of



A scheme for the Production of Copper and Nickel (according to information received by writer) as proposed by Mr. Titus Ulke, for the working of Canadian Pyrrhotite Nickel Ores at the Sault Ste. Marie, Canada. From the above diagram it will be noticed the process is a refining process and uses crude metal as anode material, necessitating roasting and smelting operations together with separation smelting to the stage of obtaining a crude metal of about 90 to 95% me al centents.

the process of all metals, especially to nickel. In fact, the production of fine nickel from crude nickel anodes, using an electrolyte of nickel ammonium sulphate, is at present being carried out on the lines indicated for copper production, and the success attending refining has led to much experimental work on lines tending toward direct production of metals from ores or furnace products. This brings us to the second phase of electrolysis; namely, the direct production of fine metal.

Many experiments were made to solve this problem by using mattes or furnace products directly as anode material in a suitable

electrolyte identically as in copper refining. It must be born in mind that, in copper or metal refining it is very necessary for economic working to have a pure anode material. Even then the electrolyte will become so fouled by the accumulation of impurities that it becomes necessary to regenerate it. The question may naturally be asked here, if impurities accumulate with comparatively pure anode material, what will be the ratio of this accumulation, and what will be the effect in using an anode material containing from 10 to 95 per cent of impurities? Upon the answer to this question hinges the direct economic production of metal through electrolysis. A number of processes tend to answer this question, and we will speak of them in the order of their priority or date. First of these is the Marchese Process, (D.R.P. No. 22429 May 2nd, 1882.) This process was given a thorough trial by the Societa Anomima Italiana of Genoa. This company built a 125 horse-power plant for a practical test, and after spending large sums of money came to the conclusion that the same was a failure. The method of working was as follows :—

1st. The smelting of copper-bearing ores to matte of about 30 per cent copper and 40 per cent. iron was accomplished by well-known methods.

2nd. This matte was cast in plates (800 x 800 x 30 mm.) by means of iron frames or molds, a strip of copper being at the same time cast into the matte to serve as connection. Later this strip of copper was supplemented by a copper wire gauze extending through the whole form. This was done in order to prevent a too rapid disintegration of the anode plate, and also to equalise the distribution of the electric current throughout the whole mass composing the anode.

3rd. The cathodes, thin copper plates (700 x 700 by 0.3 mm.) were suspended by copper strips from wooden rails extending over the bath.

4th. The electrical connection between the anodes and cathodes of a single bath and twelve baths were known as a multiple series. All the cathodes of one bath were connected to one conductor, while all the anodes were connected with the positive conductor. The connection of the first to the second bath, and of the second to the third, and so on throughout the series, were made between the cathodes of the preceding bath and the anodes of the following bath.

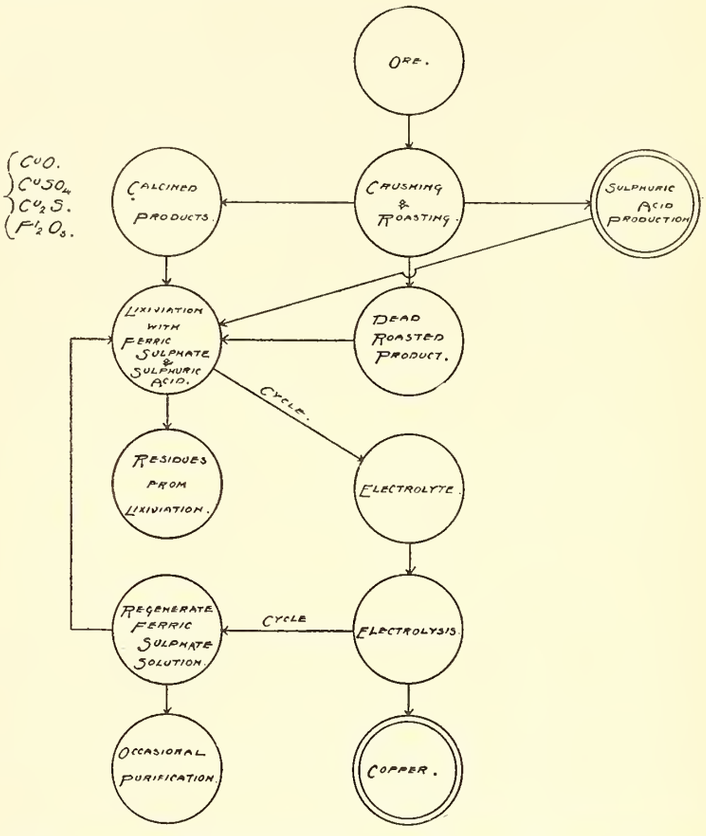
5th. The baths were lead lined wooden vats (2000 x 900 x 1000 mm. deep). Twelve of these vats set in terrace form were connected to one machine.

6th. The electrolyte was composed of a solution of copper and iron sulphate, which was obtained by roasting ore and leaching the roasted product with dilute sulphuric acid. The circulation of the electrolyte through the series of baths was accomplished by means of lead pipes connecting the individual baths, the overflow from each entering at the bottom of the succeeding bath. (The diagram giving outline of process is appended).

This process proved a failure from a financial standpoint and was speedily abandoned. The prominent reasons for this failure were the uneven disintegration of the anodes, polarization arising from the encrusting of the anodes with impurities and consequently a very high rise in voltage, and further an accumulation of impurities in the electrolyte.

Nothwithstanding the failure of the Marchese Process, certain experiments carried on in connection therewith developed valuable and interesting facts. The action of the electric currents upon iron salts, during electrolysis, was found to result in the production of ferric sulphate from ferrous sulphate. This fact was made the basis of a patent issued to Body in 1886. Although Body's process and apparatus were not limited to copper alone, but were made the issue or the extraction and recovery by electrolysis of metals in general. This process is in reality the forerunner of what are at present the two principal processes for the recovery of metals from their solution; namely, that of Siemens and Halske, and that of Hoepfner.

Body's electrolytic vat consists of a square box made of Portland cement and covered with an acid and waterproof paint. Parallel to the four sides and some distance therefrom, are four tile plates so



Outline scheme for the Electrolytic Production of Copper. Siemens & Halske (Ferric Sulphate) Process.

joined as to form a second box. The bottom of the outside box is composed of a carbon plate and is connected as an anode to the terminal of an electrical generator. The four tile plates composing the inner box are half the height of the outer box. Within the gap formed by the inner box and the bottom of the outer box, is stretched a felt cloth or some form of a diaphragm. In the space between the two vessels the copper cathodes are suspended. The electrolyte, composed of a solution of a ferric salt in salt or sodium chloride, enters the bottom of the inner vessel. Upon the carbon plate is placed raw ore. The solvent action of the electrolyte, together with the action of the electric current, dissolves the soluble part of the ore. The electrolyte, after filling the inner vessel, overflows into the outer, and here the copper, which it has taken up, is deposited. The electrolyte is drawn off at the bottom of the outer vessel.

According to Body's specifications, as the electrolyte flows through a bath, the following reactions take place :

1st. The metals contained in the ore are brought into solution by the reduction of a ferric sulphate or chloride solution to ferrous sulphate or ferrous chloride.

2nd. The dissolved metals are deposited upon the cathode.

3rd. The nascent chlorine generated at the anode reconverts the ferrous salts into ferric salts, and the excess of chlorine dissolves more metal from the ore lying in contact with, or existing as part of the anode.

Body's process was improved by Siemens and Halske. The improvement consisted in having the reactions between ferric salts and the metal in the ores take place outside of the electrolytic vats, and independent of the electrolysis. Figuratively speaking, they stored up the work at the anodes in the electrolytic baths for immediate use

outside of the baths. In their patent specifications they claim the following method of procedure :

Sulphide ores (copper bearing pyrites, etc.) are roasted at a low temperature in such a manner that the iron contained therein is mostly oxydized, while a part of the copper should be present as copper sulphate, another part as oxide, but by far the greater part as sulphide. The roasted ore is then leached with the solution flowing from the electrolytic decomposition vats. When this solution had dissolved as much copper as is possible and all the iron salts have been converted back again into the ferrous condition, the same is then returned to the electrolytic vats for copper extraction and reconversion of the ferrous salts to ferric salts. The solution is then returned to be used for further extractive purposes. This cycle continues until the solution becomes so fouled with impurities that it becomes necessary to purify the same. The chemical processes involved in leaching and electrolysis are represented in the following equations :

1.—$H_2 SO_4 + 2 Cu SO_4 + 4 Fe SO_4 = 2 Cu + 2 Fe_2 (SO_4)_3 + H_2 SO_4$.

2.—$x H_2SO_4 + Cu_2 S + 2 Fe_2 (SO_4)_3 = 2 Cu SO_4 + 4 Fe SO_4 + S + x H_2SO_4$.

3.—$Cu O + H_2 SO_4 = Cu SO_4 + H_2O$.

4.—$3 Cu O + Fe_2 (SO_4)_3 = 3 Cu SO_4 + Fe_2 O_3$.

5.—$Cu O + 2 Fe SO_4 + H_2 O = Cu SO_4 + (Fe_2 O_3 + SO_3) + H_2$.

If we compare reactions 1 and 2, we will immediately see that, provided all the copper in the ore exists as copper sulphide (Cu_2S), the solution after lixiviation contains exactly as much copper sulphate, iron sulphate, and sulphuric acid (reaction No. 2) as the solution before electrolysis has taken place (reaction No. 1). In other words, the electrolyte is completely regenerated, and can be used as such.

From reactions 3, 4, and 5 it will be seen that if the ore contains copper oxide, the solution will contain more copper, less iron, and less sulphuric acid.

It is hardly necessary to state that copper matte may be used instead of roasted ore. In this case, more iron will be brought into solution, and it becomes a difficult technical proposition to obtain solutions of the identical chemical composition. It may here be noted that in the electrolysis of the above solution, provided a good and rapid circulation exists, hardly any polarization is found to take place, and the potential difference of a bath remains constant at about 0.7 volts for the same current density, as when refining with matte or soluble anodes requiring about 1.5 volts for the decomposition of the anodes and the deposition of copper.

The electrolytic bath used by Siemens and Halske consisted of a shallow wooden vat, containing a false bottom. Upon this bottom is placed the anode, which is in turn connected with the terminal of the dynamo through an insulated cable. The anode is composed of gas retort or artificial carbon, either in plates, rods, or broken pieces. If the broken pieces are used, they receive a bedding composed of perforated lead plates. On, and covering the anode is placed a diaphragm or filter composed of felt or some other suitable substance. The space over the filter or diaphragm, known as the cathode chamber, contains the cathode in the form of a revolving cylinder, being a cylinder of wood covered with a thin sheet of pure metallic copper, which in turn, through brushes and the like, is connected to the other machine terminal. The cathode cylinder can be revolved slowly by means of suitable gearing or power transmission. The copper containing electrolyte flows into the cathode chambers in such quantities that the cathode cylinders are at all times covered by it. By rotation of these cathodes, the cathode solution is kept in constant motion or circulation. The electrolyte passes through the filter or diaphragm and fills the anode chamber, whence it is drawn off from this space formed through the false bottom. The inflow is kept constant with the outflow, thereby securing perfect circulation. The electric current enters the bath through the anodes and leaves it through the cathodes. At the cathodes the electrolyte gives up about two-thirds of its copper contents, while at the anode an equivalent quantity of sulphuric acid (SO_3+O) is liberated. The electrolyte, partially freed from its copper, flows through the filter into the anode chamber, where the ferrous sulphate, formed in the leaching of the ore, is reconverted in ferric sulphate by the sulphurous anhydride liberated at the anode. The ferric sulphate solution, on account of its higher specific gravity, sinks to the bottom of the vat and is there withdrawn, to be again used for leaching purposes. The potential difference of a bath is claimed to be 0.7 volts at 16 amperes per square meter of cathode surface. Within the last four or five years, extensive mechanical improvements have been made in conjunction with this process.

With the above process it is possible to bring into solution copper and nickel bearing materials on identically the same line as copper

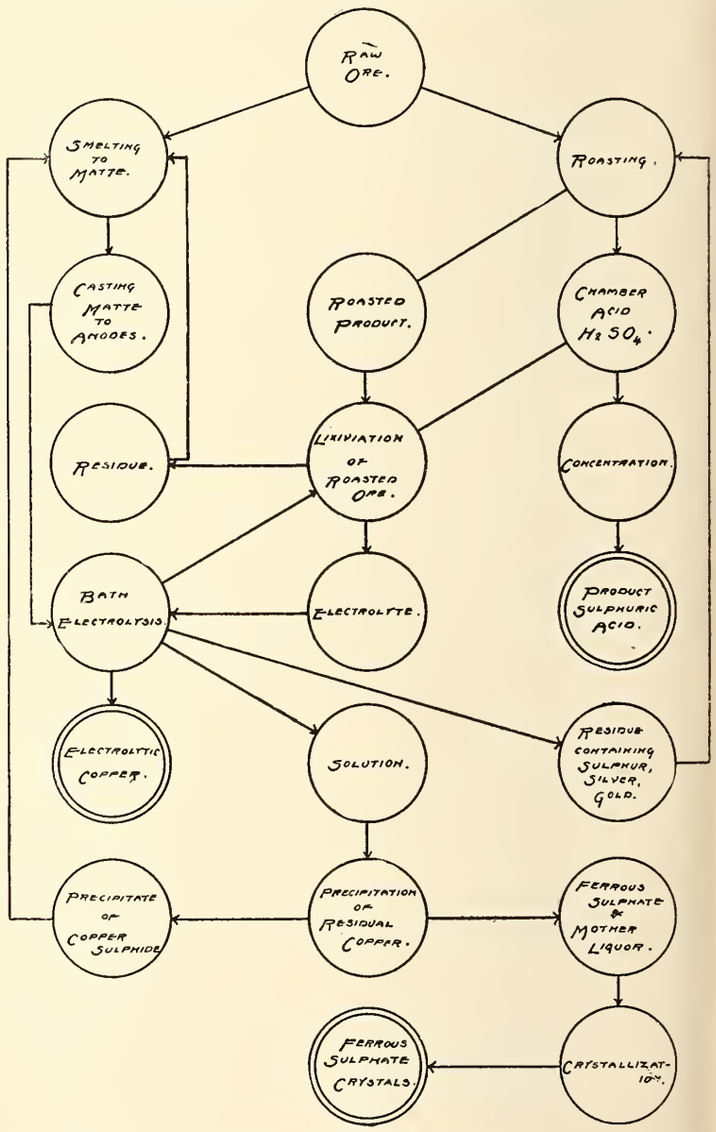


Diagram of the Marchese Process.

alone, enabling to produce copper and nickel from ores and furnace products (mattes, etc), containing both. Since copper is deposited at a different potential difference from that required to deposit nickel, it becomes possible to separate the copper from the nickel contained in the electrolyte, producing thereby a solution of nickel, iron sulphate, from which nickel can be separated either as a salt by displacement, or produced electrically in the metallic condition. It has been found that copper chloride acts similarly to ferric sulphate or chloride, in many chemical reactions—it undergoing oxidation and reduction, and

a change of valence very similar to that observed in iron salts. This property of copper salts was introduced as an improvement over the Siemens and Halske process, and we have in this the fundamental principal of the Hoepfner electrolytic process. As in the Siemens and Halske process, we have the extraction of ores or metal bearing products with cupric chloride. The cupric chloride reduces to culprous chloride the same as ferric sulphate or chloride to the ferrous condition. While the cupric chloride is being reduced, an equivalent amount of metal from the product to be leached is dissolved. The process as carried out in practice is as follows: Ore, mattes, or other furnace products, are pulverized. This finely-ground product is treated with a hot solution of chloride, associated with salt, or saline chloride solution. The cupric chloride solution should contain from 60 to 75 grms. of copper per liter. The leaching is performed either in suitably constructed revolving drums or cylinders, or by means of a jet of superheated steam acting upon the pulverized ore product and leaching solution in specially constructed vessels. (This improvement was devised and introduced by the writer while in Europe in 1896.) By this means the cupric chloride solution is converted into cuprous chloride, dissolving an equivalent amount of copper from the material to be leached. If the cupric chloride solution contains 60 grams copper per liter before leaching, after leaching it will contain theoretically 120 grams of copper per liter. This ratio is very nearly attained in practice. If the ores or mattes contain silver, gold, nickel, cobalt, etc., the same will go, in equivalent amounts into solution, producing a complex chloride solution. This solution, after arriving at normal temperature, is ready for electrolysis. By submitting this solution to electrolysis, using copper electrodes, it is possible to drive all the silver, gold, and precious metals out of solution. (Improvement devised and introduced by the writer in 1895). According to Dr. Hoepfner, to establish between electrolysis and lixiviation of ores a process constituting a true cycle, it is necessary to have the original lixiviating liquid produced by electrolysis and the original electrolyte reproduced by chemical process.

For the successful carrying out of this scheme the arrangement of the baths, the chemical composition and the circulation of the electrolyte become of the highest importance. In carrying out his process (D.R.P. 53782, March 1888) he employs baths or a system of baths divided by diaphragms into two compartments. One compartment contains anodes which cannot be dissolved by electrolysis or nascent chlorine and the other compartment cathodes of pure sheet copper.

A solution of a halogen salt and cuprous chloride circulates by itself past the anodes and a similar solution flows past the cathodes. At the cathode metallic copper separates, and at the rate of 2.36 grms. for each ampere hour, or twice as much as is deposited by unit current when a solution of an oxide salt is used, viz., copper sulphate.

At the anodes free chlorine would be produced if no cuprous chloride were present at this point, and a voltage of 1.8 volts would be necessary at the poles of the bath.

The chlorine, however, combines in the nascent state at once with the cuprous chloride which should be present to form cupric chloride. By this means a depolarization is produced which experience has shown amounts to about one volt. The electrolysis therefore practically proceeds with a potential difference of only 0.8 volts per bath.

Cuprous chloride ($Cu_2 Cl_2$) develops in its formation 65.75 calories. Now as 45 calories of heat thus developed correspond to one volt of electromotive dissociating power, $65.75 \div 45 = 1.46$ volts is that electromotive force in volts which is necessary for decomposing cuprous chloride into 2 copper and 2 chlorine atoms. $Cu_2 Cl_2 = 2 Cu + 2 Cl$.

In order to overcome this resistance in practice the tension must increase to about 1.8 volts, as with 1.46 volts the dissociating and combining power only just balance each other, so that a quantitative decomposition cannot as yet take place. When, however, chlorine in a nascent state oxidizes cuprous chloride to cupric chloride the following reaction occurs:—$Cu_2 Cl_2 + Cl_2 = 2 Cu Cl_2$. As cupric chloride ($Cu Cl_2$) represents 125.4 calories, $125.42 - 65.75$ or 59.67 calories become free and help the work of the depositing current. Theoretically, therefore, according to Hoepfner, electrolysis commences when applying only $65.75 - 59.67 = 6.08$ calories, or 0.13 volts.

The liquor at the cathodes, while successively flowing past a number of cathodes, gradually loses all its copper and leaves the electrolytic

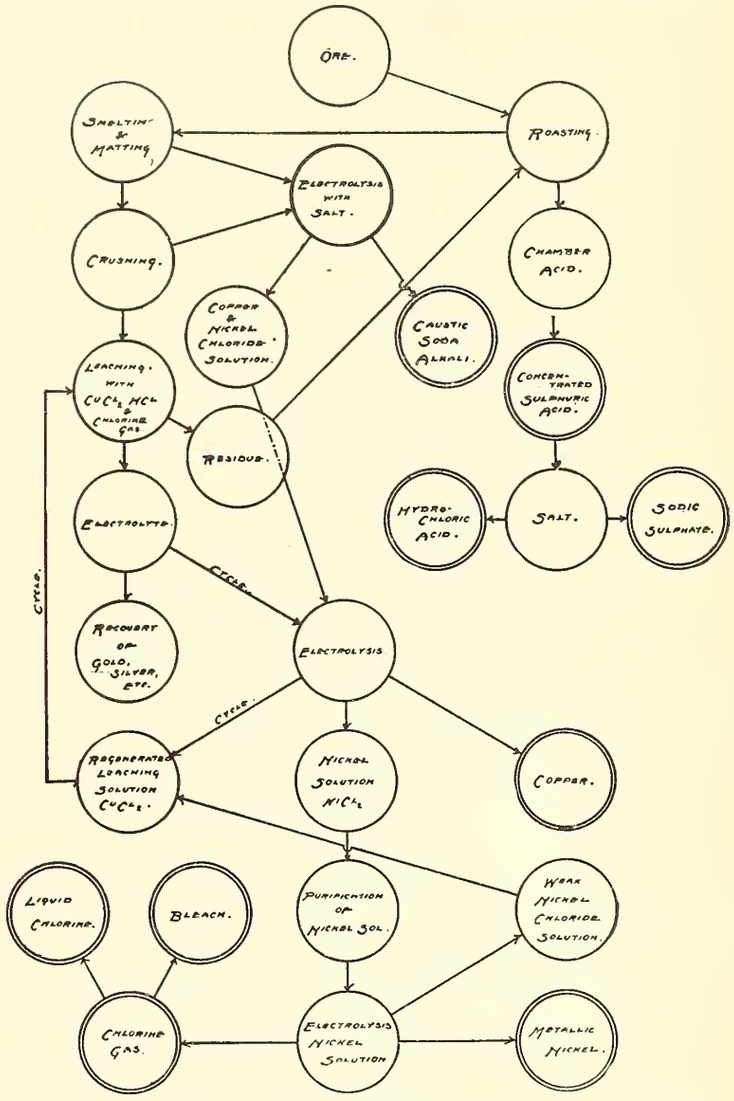


Diagram for working Chloride Solutions viz. Hoepfner Process, together with additions and improvements introduced by writer, viz.: Production of caustic (Salt Electrolysis) Liquid Chlorine, utilization of sulphur for Sulphuric Acid, Salt Cake and Muriatic Acid; also Nascent Chlorine for leaching purposes.

bath to be later on brought back into the process for completing the cycle. The liquor at the anode retains its full copper contents, but in the state of cupric chloride instead of cuprous chloride. At the electrodes the following reactions take place:—$Cu_2 Cl_2$ gives 2 Cu at cathode, while by electrolytic displacement the chlorine travels to the anode and combines with the cuprous chloride to form cupric chloride ($Cu_2 Cl_2 + {}_2Cl = 2 Cu Cl_2$).

The solution of the cupric chloride coming from the anodes is then employed for extracting copper, etc., from ores, mattes, and the like. In copper ores containing sulphide of copper the following reaction takes place:—($Cu Cl_2 + Cu S = S + Cu_2 Cl_2$.) (${}_2Cu Cl_2 + Cu_2 S = S + 2 Cu_2 Cl_2$.) This shows that the cuprous chloride formed has taken up as much copper as had previously been precipitated by electrolysis as metallic copper. As compared with the quantity of copper the concentration of the liquor is now twice as great as originally; in order, therefore, to establish the original concentration

the cathode liquor which has been electrolytically deprived of its copper and flowing from the cathode cells is added thereto. It will be seen that the above constitutes a continuous process forming a complete cycle. The cycle is distorted by the gradual dissolution of iron, arsenic, antimony and the like impurities contained in the ores or mattes which become dissolved in place of copper. This defect, however, is overcome by the removal of such impurities, more especially the iron, by the purely chemical method through the use of oxide of copper before conveying the cathode liquor to the baths.

Simultaneously with the iron, arsenic, antimony and bismuth disappear. The advantages of this process according to Hoepfner are: 1st. Twice as much copper is produced from chloride solution as from sulphate with the same expenditure of energy. 2nd. The halogen salts of alkalies and earth alkaline metals (especially calcic chloride) possess such a dissolving capacity for cuprous chloride that in case of solutions free from iron, concentrations can be effected which cannot even be remotely obtained with sulphate solutions. From this it follows that the slighter volume of liquid used in the Hoepfner process enables a smaller plant to produce the same quantity of copper as a much larger plant using sulphate solutions.

An acid solution of cupric chloride in calcium chloride is a very powerful solvent of many metals. If the solution contains free chlorine, gold, silver and allied metals are readily brought into solution, and through proper means can be readily recovered from such solutions independently. In properly constructed divided baths, having a perfect circulation of the anode and the cathode portions of the electrolyte, the writer has obtained from cuprous chloride solutions a quantity of copper comparing very favorably with the best electrolytic copper produced from sulphate solution. The voltage necessary did not exceed one volt per bath. Therefore one horse-power day, at the rate of 700 volt amperes to the horse power, produces 39.6 kilos. or 87 pounds of pure copper to the horse-power. This is double what can be obtained from sulphate solutions.

Cohen cites a very interesting experiment in the electrolysis of cuprous chloride without diaphragms. He noticed that in the electrolysis of chloride solutions at a low current density the solution of cupric chloride, regenerated at the anode, sinks to the bottom of the vessel containing it, on account of its increase in specific gravity, and there forms a definite rising stratum. If the copper cathode be of sufficient length to reach this stratum copper will be dissolved from the same. By employing a very deep bath this difficulty is overcome. His method was as follows:—A deep vessel, having a sump in the bottom thereof, a long carbon anode extending into the sump, a siphon removing the solution from the sump, a short copper cathode reaching about half-way down the bath and an inflow to supply perfectly reduced cuprous chloride solution. Cohen claims that with this apparatus a current density of 20 amperes per square meter cathode surface, and a potential difference of one-half volt per bath, he has obtained copper equal in all respects to the best copper produced by any known process. According to Cohen's claim, it would be possible figuring 700, instead of 730, volt amperes to the horse-power, to produce 79.2 kilos, equivalent to about 174 pounds of pure copper to the horse-power day. Theoretically the above is possible, but the writer thinks that practically it would be very difficult to attain any such results.

If copper nickel ores or mattes are used in the Hoepfner process after removing the copper, a solution coming from the cathode compartments of the bath will be obtained containing all the nickel, cobalt, etc., in the original electrolyte. This solution upon purification by the removal of iron, cobalt, etc., electrolyzed in proper baths, will yield nickel and free chlorine gas. The chlorine gas coming from the nickel electrolysis is in the Hoepfner process reabsorbed by a cuprous chloride solution to be further used in extracting more metal from ores and mattes, or it may be condensed into liquid, or absorbed by lime to produce bleach. The electrolysis of nickel chloride reverts back to a simple chloride solution ($NiCl_2 = Ni + Cl_2$), and for every 59 equivalents of nickel deposited there will be 71 equivalents of chlorine gas set free. The electrolysis of a nickel chloride solution is a simple and elegant technical proposition. Practically about six kilos or thirteen pounds of nickel are produced by one horse-power day. This yield is accompanied by the liberation of about 15 pounds of chlorine gas, yielding 45 pounds of 35 per cent. bleach. Sulphate and chloride solutions are of such a nature that one can almost say that what is possible with the sulphate solution is also possible with the chloride solution. It is in fact just as easy to refine from a chloride solution as from a sulphate. It is therefore possible to produce copper and nickel or any other metal from a chloride solution at the same time using a soluble anode. The electrolysis of a salt or sodium chloride solution in the presence of a soluble copper and nickel anode producing thereby a solution of copper and nickel chlorides and alkali (caustic soda), was introdnced by the writer as a part of the chloride process for producing metals (1898), that is solutions of metallic chlorides from copper, nickel ores, mattes, etc.

The electrolysis of a salt solution having as an ultimate object the production of caustic together with metallic chloride was made the basis of a patent issued to Faure, Eng. Patent No. 1742, in 1872, and again Trickett & Noad, Eng. Patent No. 7754, 1888. (For further particulars see *Electrolytic Alkali Industry*, George Lunge, Vol. 3.)

Little was known regarding the production of electrolytic nickel prior to 1840. At that time an English patent was granted claiming the recovery of nickel from the solution of the double cyanides. This patent had little value. But of greater importance are the researches of Böttger, who established the conditions upon which the production of pure nickel from nickel ammonium sulphates or chlorides depend. This suggestion toward the production of pure nickel was made the object of a patent by Andree, Nov. 1st, 1877. According to Andree, nickel ores or mattes or nickel-cobalt-copper combinations, either as sulphides or arsenides are connected with the positive terminal of an electric generator and suspended as anodes in dilute sulphuric acid. Upon the cathodes only pure copper would be deposited, while the nickel going into solution remained in solution as long as the electrolyte remains acid. Towards the end of the operation, carbon anodes replace the matte anodes and al the copper is forced out of solution, leaving an electrolyte of nickel sulphate with iron sulphate. To electrolyze this solution the same is displaced or made alkaline with ammonia, the precipitated iron separated by filtration and the resulting nickel ammonium sulphate solution electrolyzed producing thereby pure nickel. About ten years later, in April, 1888, Farmer applied for a patent upon an apparatus having for its object the production of sheet metal and the refining of crude nickel. Farmer uses a revolving drum placed in a vat containing an electrolyte of nickel ammonium sulphate, chloride or nitrate. The anode of the bath is composed of a semi-cylinder of impure nickel placed below the drum with its curvature in the direction of the drum or cathode. The cylindrical cathode revolves, thereby agitating the electrolyte. while at the same time the nickel is deposited by means of the electric current passing through the same. It is difficult to electrolytically separate from crude nickel the metals which contam, inate it. A patent was issued to Basse & Selve in 1891 having for its object the separation of nickel from iron, cobalt, zinc, etc. To accomplish this a neutral or weak acid solution, containing nickel, cobalt, iron, zinc, etc., is treated with a sufficient quantity of an organic substance to prevent the precipitation of nickel, iron, etc., through alkalies. Concentrated caustic is added to slight excess, and the resulting solution electrolyzed. At a current density of 0.3 to 1.0 amperes per square decimeter of cathode service, iron, cobalt and zinc separate at the cathode, the nickel remaining in solution or partly separates as hydrox-

ide. If the current density is large and the solution strongly alkaline, nickel will also separate as hydroxide at the cathode. In order to obtain the nickel from the purified solution the solution is treated with carbonic acid or ammonium carbonate to convert all free alkalies into alkali carbonates. The solution is then again submitted to electrolysis. The organic compounds used for the above purpose are tartaric, citric, acetic acids, glycerine, dextrose, etc. The writer has obtained very good results in this direction by the use of creosote sulphonic acids, made by treating phenoles, obtained from coal tar with sulphuric acid.

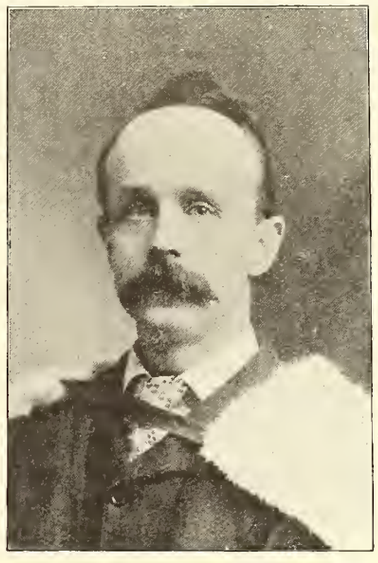
The much patented double decomposition arising when a solution of sodium chloride is electrolyzed in the presence of soluble anodes, carrying metals capable of forming chlorides, has again been made the basis of a patent granted to Frasch in 1901. The Frasch process was supposed to be an improvement on the Hoepfner process and was expected to supercede it and completely revolutionize all methods involved in the electrolytic production of metals. Much was claimed for the process by the inventor, but little has been realized, as the result of its work at Hamilton, Ontario, show. Sufficient critical comment upon the Frasch process has appeared within the past year to make further details regarding it unnecessary here. It is the writer's opinion that the patent for the Frasch process was granted as the result of the exertion of a shrewd patent solicitor rather than the public recognition of an invention containing new and original ideas on the subject of electro-metallurgy.

Hoepfner's process, or rather the legitimate electrolysis of chloride solutions, is a commercial success, as is evident from the fact that, 1st, the Papenburg Works in Europe continue to operate the same; 2nd, the Canadian Copper Co. are daily producing a ton or more of metal from chloride solutions, and, 3rd, zinc production from zinc chloride, which is technically a much more difficult problem than nickel from nickel chloride, is successfully carried on at present at the Brunner-Mond works in England. It stands to reason, therefore, that the failure of the Frasch process, judging from results at Hamilton, must be explained in other ways than in the technical difficulties surrounding the electrolytic decomposition of a chloride solution.

In the production of metals by the Hoepfner or by the Siemens & Halske process the question of diaphragms is an important one. The reactions occurring at the cathodes are always of a reducing nature, while those at the anodes are always of an oxydizing nature. The result is that the electrolyte surrounding the anodes is of a different chemical nature from that surrounding the cathodes and it becomes necessary, therefore, to keep the electrolytes separated by a substance having the property of allowing the individual ions to pass, but at the same time preventing the anode and cathode solutions from mechanically mixing. In the earlier experiments felt, cotton cloth, jute, parchment paper, etc., etc., were largely used. Hoepfner uses nitrated cotton-ducking to advantage. In recent times porous tiling and the like (porous cup material as used in two liquid or primary elements) has come extensively into use. The writer is informed that the Canadian Copper Company is using this substance at the present time in the construction of its baths. The Pukall porous cups and diaphragms manufactured by the Royal Berlin Porcelain Company of Europe, are coming into extensive use. Asbestos cloth, mineral wool, spun glass, sand, cements, etc., etc., in almost every conceivable form and combination, have been patented for the above purpose. Although there are innumerable patents, good, bad and indifferent, affecting the manufacture and use of diaphragms, very few of them give satisfactory results.

From what has been said it will be seen that the electrolytical production of nickel and copper as at present carried on reverts back to two fundamental methods, namely: 1st. The production from sulphate solutions; and, 2nd: The production from chloride solution, and any variations of method claiming to introduce new and original ideas or novelties are more of a mechanical than a chemical nature. It was the intention of the writer to furnish a list of patents on this subject, but the number is legion, and it was thought better not to cumber this paper with information which can be had from the Patent Office. In fact, the chemical and mechanical part of electrolysis has been so many times patented that doubt is thrown upon the merit and validity of each and every patent of this nature now upon the market. The question continually arises: Which of these patents are good, and to whom should the producers of metals pay royalties? So uncertain is the answer to these questions that resort is more and more made to the courts, and pending their decision capital is tied up and production stopped, and a new element added to the uncertainties of metallurgical and mining operations which should be as positive in operation as they are scientific in method.

Appended are outline schemes showing the more prominent features of the different processes in use.



MR. E. V. CORLESS, B.Sc., McGILL

Who was awarded the President's gold medal for the best Students' paper presented to the Transactions of The Canadian Mining Institute during 1901.

BELL'S ASBESTOS.

The directors beg to submit to the shareholders the report and audited accounts for the year ended 31st December, 1901.

The result of the year's operations is a net profit of.....	£ 16,824.16.6
To which has to be added the amount brought forward.....	1,913.14.2
Leaving for appropriation.....	£ 18,738.10.8

The directors recommend:—

1. The payment on the 7th April, of a dividend at the rate of 6 per cent. per annum, free of income tax.
2. To place to reserve fund £9,000.
3. To carry forward £2,538 10s. 8d.

The trade of the company in raw and manufactured asbestos and machinery, and the result of the working of the company's mines in Canada, showed considerable improvement during the year.

Asbestos in Vermont.—In a report to the Directors of the Geological Survey of the United States, Mr. J. F. Kemp has something to say of the occurrence of asbestos in the State of Vermont, which will, we are sure, be of interest to those of our readers who are interested in the production of the mineral in Canada. He says :—

The asbestos occurs in two distinct and contrasted varieties. In one case it forms veins which ramify in every direction through the serpentine. The asbestos fibres are perpendicular or at a high angle to the walls, and vary from a maximum length, as at present exposed, of ¾ of an inch, down to not more than 1-16 of an inch. The variety is similar in all respects to the Canadian product but it is met only in the prospects owned by Mr. Tucker at Tucker's Mill and near Lowell. The second variety of asbestos is what, for lack of a better name, I will call "slip-fiber" because it occurs upon the slickensided surfaces that are common to this exposure of serpentine, just as to all others the world over. These fibres form layers of varying thickness, seldom more than ¼ of an inch, but as they run parallel to the slickensided surfaces they may themselves be of various lengths, from a fraction of an inch up to 3 or 4 inches. The fibre is coarser than that of the veins, and will not furnish so good a grade. At the same time it occurs in larger quantity. This is the variety of fibre which will be produced by the New England and the National companies. It also appears in a minor degree in the other openings.

The developments of the New England company are the most advanced. Foundations have been laid for a mill of an estimated daily capacity of 400 tons. An engine-house has already been erected and equipped, and a superintendent's house is nearly completed, in addition to boarding houses for the men. The mill is admirably located, so that from the cliff of asbestos rock, which rises to the north of it and is much higher, the crude material will be run into it on tram cars and will pass by gravity through the concentrating process. The mill will, in the natural order of things, be productive in 1902.. At the National company only a small open cut has been made, in order to expose the deposit. The writer was unable to learn whether the installation of the mill, etc., is immediately contemplated or not. In the town of Lowell the enterprises have as yet only reached the stage of open cuts. In the openings thus far made near Lowell the quantity is apparently not so great as at Tucker's Mill, although the general quality appears to be much the same.

There is little doubt that the region will become commercially productive, and that very considerable amounts of asbestos will be contributed by it to the markets.

Canada's Great Nickel Deposits.—Dr. A. E. Barlow in a short summary of his investigations in the Sudbury District last year for the Geological Survey concludes: It is now confidently believed that the nickel and copper deposits of Sudbury are the most important of their kind known in the world. The inauguration of the extensive and well equipped works of the Mond Nickel Company at the Victoria mines, and the extension of the works of the Canadian Copper Company, will rapidly place Sudbury in the foreground of the nickel-producing areas of the world.

Graphite Mining in Canada.—It is understood that the property owned by the Walker Mining Company, Township of Buckingham, Que. has been sold to a strong American Syndicate and that on the completion of certain negotiations with the old mortgagees, work will be prosecuted on an extensive scale. During the past year considerable progress was made in this industry and the outlook for a larger production of this valuable mineral in Canada is more hopeful. Work was prosecuted at the deposit at Calumet and some selected mineral was shipped. The North American Graphite Company worked during most part of the year and shipped a number of car loads of the finished product of its mill. It is hoped that the investigations and experiments during past years, made by this company, have resulted in such improvements in the methods and machinery for the treatment of the rock that the difficulties encountered in the past will no longer debar the development of the extensive deposits of graphite-bearing rock of the vicinity. In Ontario, the Ontario Graphite Company has been taking steps to extend its operations by erecting a mill for the treatment of the ore.

Copper Production in New Brunswick.—In his report to the Geological Survey just issued, Prof. L. W. Bailey makes reference to the important copper mining operations now being carried on by the Intercolonial Copper Company at Dorchester, a subject by the way, on which we will have something further to say in a handsomely illustrated article in next month's Review. Professor Bailey says:—The conditions of the occurrence of ore at this point have been given in earlier reports. The ore is of low grade, not averaging over 3½ per cent. of copper, but is widely disseminated through the mass of the rock, from which, it is thought, that by the employment of new and improved processes it can be profitably extracted. For this purpose a large and expensive plant has been introduced, but at the time of our visit it had not yet been brought into operation. It is proposed to crush the entire rock, consisting of grey conglomerate and sandstone, more or less mixed with coaly matter and containing the ore, mainly chalcocite, in veins and scattered nodules, and, after roasting and treatment with acids, to separate the copper by electrical action. As copper ores of a like character and with similar associations are known to occur elsewhere in the province, as on the Nepinquit river, near Bathurst, the results of the operations at Dorchester will be awaited with interest.

CORRESPONDENCE.

The Lead Question.

Sir—I find from the Unrevised Statements of the Imports and Exports of the Dominion of Canada, that for the year euding June 30th, 1901, the imports of lead in all forms into Canada amounted to 11,394 tons, and for the half year ending December 31st, 1901, to 9,131½ tons.

The extremely low price prevailing in the latter period stimulated importation, and the figures quoted are probably the largest ever shown for any half year period.

Taken together, the quantity of 20,000 tons for 1½ years, indicates an average consumption of Lead in Canada of about 13,000 tons per annum, which agrees with the estimate generally made by those interested in the production of the article.

The United States appears to afford a market for about 280,000 tons of lead. Allowing our population to be one-fourteenth of their's, we should use in Cauada about 20,000 tons per annum.

That we do not is due to two causes :—

1. That lead is largely used used in roofing, and in plumbing in large aud costly buildings, such as are found only in great cities, and of great cities we have proportionately fewer than they.

2. Thrifty, enterprising, and well-to-do people, use lead paints largely, for the preservation of their buildings and for decorative purposes. Those less wealthy, and less advanced in aesthetic culture, are content with whitewashes and ochres, or to allow their structures to stand four square to all the winds of heaven in native wooden nakedness.

As we have now emerged from the pioneer stage of Canadian experience, we may expect to see our comparative deficiencies in this respect immediately supplied.

Not only, from this time on, will our houses and barns of new erection be painted before occupation, but accumulated arrearages will be made

good. All the old houses, and barns, and mills, and fences in the country will also be painted, so that the consumption of lead in Canada in the immediate future may be expected to reach not only a per capita ratio equal to that of the United States, but a higher figure, let us assume, 20,000 tons per annum.

In some appreciative remarks in regard to the lead mining situation in Kootenay, B.C., printed in your February number, you state, and quite rightly, that the crux of the question is that of a market, but you speak somewhat hopelessly of the value of our own home market.

It is a fact that the present ruling prices for lead in the London market are very unfavourable. In July, 1900, lead was worth in London £18 per long ton. In November 1901, it was down to £10 5s. Lately it has advanced to £11 7s. 6d, equal to $2.45 per 100 pounds.

At this rate the B.C. miner receives $1.46 per 100 lbs (being the London price, less $1.00 per 100 lbs. retained for refining and transportation to London) or for ore carrying 50 per cent. lead the miner receives $1.46 per 100 lbs. for 900 lbs., equal $13.14 per ton of ore, whereas freight and smelting charges are $15.00 per ton, leaving a balance of $1.86 to be paid out of the silver contents of the ore, together with cost of mining, conveyance from mine to railway, and all other charges.

The present price of silver (53 cents per oz.) is almost as low as has ever been known, and the situation is that only mines exceptionally high grade in silver can work.

The production of lead in B.C. in 1900 amounted to 31,000 tons, and the production in 1901 to 28,000 tons, but that it was maintained for the latter year at so high a figure was due entirely to the impetus given by the high prices of the year before.

The great lead producing mines of B.C. are now closed, and must remain so until prices rise, or the very distasteful alternative is resorted to of a lower rate of wages to miners.

The production of lead in 1902 will certainly not amount to 20,000 tons, and may not exceed 10,000 tons, so that had we the opportunity of supplying in full the Canadian market we would have for this year no exportable surplus.

Lead mined and smelted in Canada and refined abroad is now readmitted into Canada by payment of duty only upon the cost of refining.

There being as yet no refinery in operation in Canada, our smelters avail themselves of this privilege to the extent of supplying fully the Canadian demand for lead in the form of pig.

Of the total consumption of lead products in Canada, however, one half consists of "corroded" lead, the material which, when ground and mixed with oil, becomes lead paint.

By a maladroit arrangement of the Canadian tariff it occurs that the foreigner who is impeded by a 15 per cent. rate of duty (or if an Englishman by a rate of 10 per cent.) from shipping his pig lead into Canada, can by subjecting it to a further and important process of manufacture, get it admitted as raw white lead, at a 5 per cent. rate (or if an Englishman at 3⅓ per cent).

Against the competition of concerns in the United States and the Old Country, already engaged in the corrosion of lead on a large scale, with facilities already provided, and ample capital already invested, it is almost useless to expect the establishment of the business of lead corrosion in Canada, with a tariff fence so low as this.

I do not wish, for a moment, to use your paper as a medim through which to obtain circulation for a contribution to the current discussion upon the trade policy of the Government.

This particular item of the tariff was fixed as at present at a time when there was no lead production in sight in Canada, and now that conditions have changed, it necessarily awaits a convenient opportunity for readjustment.

In the meantime it amounts to the offer of a premium for the manufacture abroad of an important article, the raw material for which is a drug in our own market.

I am aware that a proposition to increase this rate of duty will meet the objection that an increased price to consumers of paint will be involved, but there is no evidence that this would follow.

The duty upon mixed paint is now 25 per cent., and this I fancy fixes the price of paint mixed at home.

While our miners in B.C. receive for lead $1.46 per 100 lbs, their neighbours in the Coeur DeAlenes camp get from the Lead Trust of the United States $3.50 per 100 lbs., and yet the price of white lead in oil is practically the same (about $5.50 per 100 lbs) on both sides of the line.

I do not claim that while the present excessively low price of lead continues, that there is any very happy solution for the difficulties of the lead mining camps. But the opportunity to supply in full our own market would save the industry from extinction.

Even with last years' production of 28,000 tons, the sale at home of one-half, at London price without the deduction of freight to London, will greatly facilitate the disposition of the other half. And this could, I think, be accomplished if lead were given in the tariff the same treatment accorded similar lines of goods.

Bounty upon Refining.—In the Session of 1901, the sum of $100,000.00 per annum was appropriated by Parliament to be paid out during five years beginning July 1st, 1902, at a rate of $5.00 per ton of refined lead for the first year, with a decrease of $1.00 for each year.

Under the stimulus of this offer, a refinery in connection with the works of the Canadian Smelting Co., at Trail, is in an advanced stage of construction , and the Marysville Smelting Co. have also announced their intention of establishing one in connection with a smelter which they have under way at the Sullivan line in East Kootenay. At the time that this bounty was offered, the price of lead was about £14, and a production of about 30,000 tons per annum was being maintained.

The price of silver was at the same time 65c per oz., and an advance to 75c. was freely predicted. When a few months later lead fell to £10, and silver to 53 cents, the production fell off 50 per cent. or more, and is now proceeding, as I have said, at a rate of from 10,000 to 20,000 tons.

At the beginning of 1902 the B.C. smelters and railways met the necessities of their customers by a cut of $4.00 per ton of ore in freight and treatment charges.

It is possible that the present charge ($15 per ton upon average ore) would admit of further reduction, if it were possible for the smelters to market the lead bullion without loss.

The deduction of $1.00 per 100 lbs. from London price does not, however, come near meeting the actual cost of refining a ton of bullion, paying freight from B C. to London, and meeting the inevitable charges for commission, interest, etc., involved in the transaction.

The total of these charges is nearer $1.75 per 100 lbs. than $1.00, so that the whole of the earnings of the smelter for the treatment of ore would be lost in the cost of marketing, if the whole of the lead production was actually shipped to London.

That the business is continued at all under present conditions is due to the fact that a portion of the output is marketed in Canada, and another small portion in China and Japan, at prices slightly better than London and with a great saving in freight.

A readjustment of the terms upon which the bounty of last year was offered, maintaining the limit of expenditure as now at $100,000 per annum, but allowing it to be paid at a higher rate per ton in case the total production falls below the amount at which the whole appropriation could be earned at present rates, would afford sensible relief to a badly harassed industry, and would be but justice to those who in good faith are investing their money in lead refineries.

It is promised by the smelting companies that in order to promote the establishment of works in Canada for the corrosion of lead, a price will be made upon lead pig, such as will enable such an industry to meet outside competition, even under the unfair existing tariff conditions.

One thing is certain, that to the ore shipper the irreducible minimum of price has been reached, and that the benefit of every concession that can be obtained by the smelter or the refiner must be transferred to the producer under penalty of a total cessation of ore supply.

G. O. BUCHANAN.

Kaslo, B.C., 15th April, 1902.

SIR—I beg to call your attention to the present condition of the lead smelting industry in British Columbia.

Two years ago the Trail smelter settled with the lead mines on the basis of New York quotations for lead, less the duty of 1½c. per lb. on lead contents. In making fresh contracts, however, the manager of this smelter represented that it would be more satisfactory to the mine owners to settle on the basis of London quotations for lead, which would yield them quite as much. Accordingly new contracts were made on the basis of these quotations, less $16 to $18 per ton freight on the lead to London. At the beginning of the present year, however, the rate of freight was raised to $20 per ton, besides an increase in smelting charge, and shortly after lead in London dropped about 40 per cent below New York quotations. The

result has been that the lead mines have been receiving about 1½c per lb. net instead of 2½c. per lb., which they would have received for the lead on the basis of the New York quotations, less duty.

The Trail smelter may claim that they are obliged to ship their lead to London, but *if they had closed down* altogether the lead could have been shipped to the United States so that it would yield 2½c. per lb. In other words, the C.P.R., instead of fostering the lead industry, as they promised to do, have been causing it a serious injury by keeping their smelter in operation. The actual difference to mines carrying 50 per cent. of lead amounts to between $10 and $12 per ton.

This explanation may be rather involved, but it is correct, and I think it would be well for you to have a paper on the subject by some of the British Columbia engineers, who are thoroughly familiar with the subject.

This of course brings up the question of refining of lead in this country, which is the most important matter now before our present Government. The refining of copper should be dealt with at the same time.

I daresay that these matters are before you, but I take the liberty of drawing your attention to them.

Yours truly,

CLARENCE J. McCUAIG.

Montreal, 2nd April, 1902.

SIR—In 1899 all of the lead ores of the Kootenay were purchased exclusively by American smelters, which at that time had not been formed into a trust. The basis of the purchase of these ores was to allow the mines 90 per cent. of the lead at the New York quotation for lead, less the duty of 1½c, per pound on 100 per cent of the lead contents, allowing the mines 95 per cent. of the silver and deducting $20 per ton for freight and treatment charges.

The smelters first purchasing ores in the Kootenay country paid the 1½c. per pound on 100 per cent. of the lead contents and sold the resulting lead in the United States; this being possible on account of the very high price of United States lead as compared to the London figure. During 1899, and especially the latter part of 1899, it was found in the smelters' interests to take advantage of the bonding privilege accorded by the United States government, smelt the ore in bond and export 90 per cent of the lead imported in it. In other words, these smelters were purchasing foreign ores, British Columbia ores, on the basis of prices paid for metals in New York and selling in the London market. There being no fixed relations between the price of lead in London and that in New York, it was self-evident that there was no more sense in basing the price of British Columbia ores on the United States prices for lead than there would be in basing such prices on quotations for lead in Russia.

In the fall of 1899 it was decided by all the American and Canadian smelters that instead of purchasing ores on the basis of the New York price it would be advisable to change to the prices in the market where the metals were sold, namely, London.

In December, 1899, the price of London lead was about £16 17s. 6d., which, with a deduction of $14 from the London price was equivalent to about $58.92 per short ton. At the same time the New York price was $4.45 per 100 pounds, or $89.00 per short ton, and with a duty of 1½c. deducted on 100 per cent. of the contents, the net amount paid per ton for British Columbia ore was $55.66. In other words, the amount which was agreed the smelters would allow the British Columbia mines in December, 1899, amounted to $3.26 per ton of lead better on the London basis than it was on the New York basis. This on a ton of 50 per cent. lead ore (assuming payment for 90 per cent. of lead contents) amounted to $1.46 per ton of ore.

It would be impossible for any smelter manager or mine owner to prophesy for any length or period of time as to what the relative prices in London and New York would be for the next two years, but the statements which I enclose for your perusal show that during the year 1900 the mines of British Columbia (assuming their ore to contain 50 per cent. lead) received on an average of $6.09 more per ton of ore shipped than they would have received had they remained on the old basis in which they were allowed the New York price less the American duty.

In the year 1901, it will be noticed that on account of the very low price of London lead, the mines would have received more for their lead had they been paid on the New York basis. It must be taken into consideration, however, that the freight and treatment charges in 1901 were reduced $1.00 per ton as compared with 1900. Leaving out the question, however, of this reduction, the mines of the Kootenay country are shown by this statement to have gained on account of this change to the London basis $230,000, or an average of $2.22 per ton of ore, assuming freight and treatment charges to have been constant, which, as explained above, they were not, for in fact contracts were made in favor of the miner to the extent of $1.00 per ton during the year 1901. Please keep in mind the fact that in December, 1899, when the change was made, that it figured in favor of the miner to the extent of $1.46 per ton of ore, while the average for 1900 and 1901 shows that the mines have netted $2.22 per ton more than they would had they been left on the New York basis.

I give you the above figures assuming that there might have been a grain of truth in Mr. McCuaig's statement that the Trail smelter was responsible for the change. But this statement upon Mr. McQuaig's part is untrue, as the American smelters have continued to purchase ores in British Columbia to almost the same extent as they did previous to the starting of operations at Trail, and the basis used in the purchase of these ores was exactly the same by the smelters in the United States as that adopted by those in Canada.

Certainly the Trail smelter is not responsible for the formation of a gigantic trust in the United States, which is the real cause of the withdrawal of certain of the American smelters from purchasing British Columbia ores in 1901. In the first place the Trail smelter is not sufficiently powerful to keep the American Smelting and Refining Company out of this market, and had the Trust wished to purchase ores at the ruling prices in the country, they would have proceeded to have done, just as the Everett smelter and the Selby Company have been doing.

As a matter of fact, the management of one of the largest lead producers opened up a correspondence during the fall of 1900 with the management of the American Smelting and Refining Company, and asked them to kindly quote a treatment charge on their output for the year 1901, stating that he would arrange freight rates to whatever smelting point they might wish to take his ore. The management of the Trust was at first evasive, but finally replied to the effect that they were not in the market for British Columbia lead ores, shewing that neither the Trail smelter nor freight rates made by Canadian roads had anything whatsoever to do with their absolute withdrawal from the market. The real causes for their withdrawal were two :—

1st—There was no profit to be made in British Columbia lead ores at the ruling prices of the country.

2nd—They had more lead in the United States than they could possibly take care of, there being a shortage of dry ores and a tremendous overproduction of lead ores. To prove that this is the cause I will only state that in the Coeur d'Alene country the Trust paid certain lead mines as high as $18,000 per month to keep them closed ; in other cases they paid $10,000 and $12,000 per month to mines to get them to reduce their output one-third.

As a further proof of the above statement it would be well to refer to a copy of the report made by Mr. S. S. Fowler, Consulting Engineer of the Whitewater Mines, Ltd., taken from the *B.C. Review*, of London, of December 14th, 1901, in which the Chairman states in part as follows :—

" At the end of last year your directors had hope that the mine had entered upon a dividend-paying basis, with every prospect of its continuance. It was, therefore, with considerable consternation that we were met with the decision of the *American Smelter people to cease taking lead ores from British Columbia, except upon exorbitant terms.* We thought, however, that this condition of things would be of short duration, and continued full operations at the mine and mill until March last, when the mill was shut down, and work confined to development only. In April all hands were discharged, except the small force necessary for keeping the workings in good order, and it was not until July last that we succeeded in making terms with a local smelter for the treatment of our ore, which terms Mr. Fowler describes *as more favourable than those we had been having from the American smelter.* Operations were continued with one shift until August, since when full operations have been resumed. I think, also, that we may look forward to some considerable improvement in the smelting position—in the first place, owing to the liberal action of the Dominion Government in granting a subsidy upon lead locally refined, and, secondly, from the competition of local smelters with those of the United States, which is likely to follow. In fact, we understand that a local refinery will before long be established at Nelson, which place is no great distance from our mine. Our difficulty has been that there was practically no demand for the ore, such as the Whitewater mine produced, in Canada itself. Almost all the ore from our part of British Columbia has had to go to the United States, and *we have had to take what terms the American smelters would give us.* We hope, however, that the outcome of the establish-

ment of the local smelter and refinery I have referred to will be to promote competition and to offer a ready market for our productions."

As still one more additional proof of the looseness of Mr. McCuaig's statements I wish to state that a special correspondence was opened between the Great Northern Railway and the American Smelter Trust, by which the Great Northern Railway endeavoured to get the American Smelter Trust to come into the British Columbia market. The result of this correspondence was that the American Smelter Trust said they would advise them further in case they decided to purchase British Columbia ores. This ended the correspondence, and nothing more was heard from the Smelter Trust.

At the beginning of the year 1901 British Columbia was turning out in the neighbourhood of 300 tons of lead ore daily, which was far in excess of the tonnage that could be handled by the smelters located at San Francisco, Everett, Trail, and Nelson. For this reason the Canadian Pacific Railway Company undertook to and did market a large amount of ore in Germany and other European countries; they would have been glad had the American Smelting and Refining Company taken this tonnage, but the correspondence above referred to between the management of one of the large properties and the Smelter Trust was certainly conclusive so far as convincing the railway companies that the Trust would not purchase any ore in British Columbia at any price.

Mr. McCuaig states that the actual difference to mines carrying 50 per cent. lead amounts to between $10 and $12 per ton. He is not very explicit as to exactly what he means; under any interpretation his statement is not correct. Assuming for a minute that there was some truth in it, no American smelter could possibly purchase British Columbia ores at New York prices, less the duty, when New York prices are at their present figure and London prices are £10 10s., as such a procedure would mean a tremendous financial loss to any such company. There is, in other words, more lead being produced in the United States than they can possibly take care of. They must of necessity, therefore, export lead originating from Mexico and British Columbia under the bonding privilege, or else export lead originating in the United States for which they had paid $80 per ton, and sell it in London, where they would receive 46s. per ton.

In conclusion, I wish to state that the Trail smelter was simply one of a number of smelters which decided for business reasons that it would be well to change the method of purchasing British Columbia ores so that the metal quotations used would be those of the country in which they would sell their product.

Second: That a change made from the New York to the London basis has resulted in round numbers in an advantage of $230,000, or approximately $2.22 per ton of ore, to the mines during the years 1900 and 1901.

Third: That the American Smelting and Refining Company withdrew from the British Columbia market because they were not willing to purchase British Columbia lead ores at the ruling prices in the country, and furthermore, because they had more domestic lead ores than they could handle, as shown by their paying lead mines with which they had contracts to keep closed.

Fourth: Every effort was made by the Railway Companies and the mine owners to induce the Smelter Trust to continue purchasing ore in British Columbia and that all such attempts proved futile.

Fifth: The entrance into the British Columbia fields by local smelters certainly had the tendency of giving the miners a better price for their lead ores, and had it not been for these smelters the bulk of the mines of the country would have have had absolutely no market to which they could have shipped their product during the year 1901.

To show the feeling of the mine owners of British Columbia, I enclose for your information copy of a resolution which was unanimously passed at Nelson, June 28, 1901.

Yours, etc.,

LEAD MINER.

Nelson, 21st April, 1902.

P.S.—Please keep in mind that the freight and treatment charges in 1899 were $20; in 1900, $20; in 1901, $19; and in 1902 it has been proposed to make charges $15, reducing the zinc limit, however, from 10% to 8%.

NOVA SCOTIA STEEL AND COAL.

Your Directors submit herewith the first Annual Report and General Statement of assets and liabilities, and abstract of Profit and Loss Account for the year ended December 31st, 1901.

The company was organized June 28th, 1901, to take over as a going concern as from the 1st January, 1901, the business, assets and liabilities of the Nova Scotia Steel Company, Limited. The reports and statements now submitted therefore include the business for the calendar year 1901.

The capital of the company consists of:—

50,000 shares of Common Stock	$100 00 each
20,000 shares of 8% Accumulative Preferred Stock.	100 00 each

of which 30,900 shares of Common Stock and 10,300 shares of Preferred Stock were issued in payment of the property, business and assets of the said, The Nova Scotia Steel Company, Limited.

An issue of 30 year 6 per cent. gold bonds of the company was made, and the bonds of the Nova Scotia Steel Company, Limited, amounting to $1,500,000.00, were redeemed at par.

The company mined and disposed of over 350,000 tons of iron ore; 238,000 tons of coal; and 26,000 tons of limestone and dolomite. Upwards of 52,000 tons of pig iron and steel ingots were produced.

The prospects for the year 1902 are favorable. Large quantities of coal and ore will be required to meet the sales already made and the requirements of the company for the year.

A coal washing plant and the first block of coke ovens at Sydney Mines are completed; excellent coke has been made and shipped to the blast furnace at Ferrona.

The erection of a new coal shipping pier at North Sydney is progressing favorably, and it is expected that it will be ready to be used during the present shipping season.

In order to increase the output of coal, new slopes, on the Sydney Mines coal areas, are now being opened up. As the work progresses, the output will gradually increase, and it is believed that by the end of 1903, the development work will be completed and the new mines producing to their full capacity.

Contracts have been entered into for the blowing engines, and a large portion of the material required for the construction of a new 200 ton blast furnace, for which the capital is now provided. The site has been selected at Sydney Mines, and the work will be prosecuted as rapidly as possible.

All the products of the company now being sold at thirty days, net cash, the loss in the collection of accounts should be very small, and every effort will be made by the management to maintain the business on this basis.

The profits for the year ended December 31st, 1901 amount to		$508,936 79
To which add balance at credit of Profit and Loss Account of the Nova Scotia Steel Company, Limited, December 31st, 1900		242,030 24
		$750,967 03
Which your Directors recommend be distributed as follows:—		
Interest on Bonds	$ 93,237 84	
Dividend paid on Preferred Shares to July 1st, 1901	41,200 00	
Dividend on Preferred Shares to January 1st, 1902	41,200 00	
Reserve Funds for depreciation, plant, renewals, etc	100,000 00	
Dividends on Common Shares at 4% payable April 15th, 1902	123,600 00	
Balance at credit of Profit and Loss Account carried forward	351,729 19	
		$750,967 03

The Directors have decided that so long as the earnings justify, dividends on the preferred shares should be payable quarterly, and on the common shares half yearly.

All of what is respectfully submitted.

CANADIAN MINING INSTITUTE.

EASTERN ONTARIO SECTION.

A PUBLIC MEETING of Mine Owners, Mine Managers, Mining Engineers and others interested in promoting the welfare of the mining industry in Eastern Ontario, will be held in the **CITY OF KINGSTON, ONT.**, on

Tuesday Evening, 6th May, 1902

for the purpose of completing the Eastern Ontario Section of the Institute.

B. T. A BELL, *General Secretary.* CHARLES FERGIE, *President.* W. L GOODWIN, *Chairman.*

CANADIAN MINING INSTITUTE.

NOVA SCOTIA SECTION.

A PUBLIC MEETING of Mine Owners and Mine Managers, Mining, Civil and Mechanical Engineers, and all who may be interested in promoting the welfare of the profession and industry of mining in the Province of Nova Scotia, will be held **AT SYDNEY, CAPE BRETON**, on

Friday Evening, 13th June, 1902

for the purpose of completing the organization of the Nova Scotia Section of the Institute.

A programme of papers on subjects of interest to the coal, iron and gold mining members will be presented.

B. T A. BELL, *General Secretary.* CHARLES FERGIE, *President.* C. SHIELDS, *Chairman.*

CANADIAN MINING INSTITUTE.

EASTERN TOWNSHIPS SECTION.

A PUBLIC MEETING of Mine Owners, Managers and Mining Engineers, and others interested in the mining industries of the Eastern Townships of Quebec, will be held **AT SHERBROOKE, QUE.**, on

Tuesday Evening, 10th June, 1902

for the purpose of completing the organization of the Eastern Townships Section of the Institute. A programme of papers will be submitted for discussion. All mining men cordially invited.

B. T. A. BELL, *General Secretary.* CHARLES FERGIE, *President.* GEO. R. SMITH, *Chairman.*

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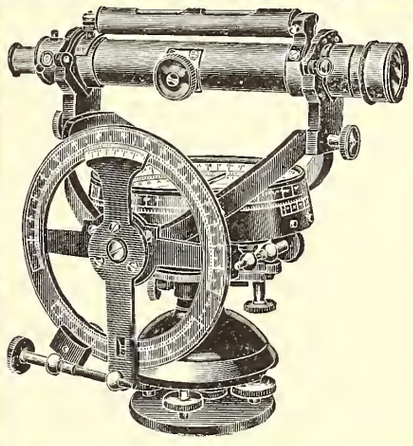
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FOR CALENDAR OF THE SCHOOL AND FURTHER INFORMATION APPLY TO

Dr. W. L. GOODWIN,

DIRECTOR

SCHOOL OF MINING, KINGSTON, ONTARIO.

Did You Hear the Thunder?

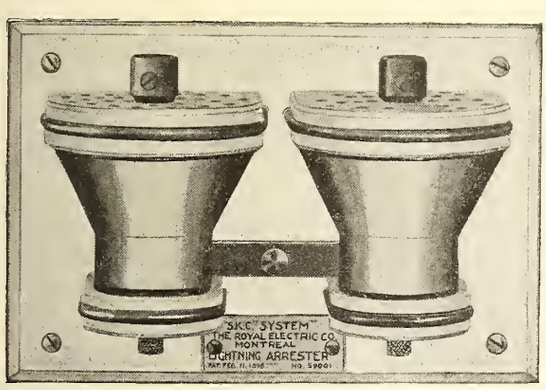
Where there is thunder there is lightning. Every electric plant should be provided with Lightning Arresters which will **PROTECT!**

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IS THE

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the IMPERIAL LIMITED trains, crossing the continent in 97 hours, will leave Montreal and Toronto for Vancouver every Sunday, Wednesday and Friday, June to October.

First-class Sleeping and Dining Cars attached to all through trains.

Quickest route to the Yukon via the C. P. R. to Vancouver, C. P. N. steamships to Skagway and White Pass Railway and connecting steamers to Dawson.

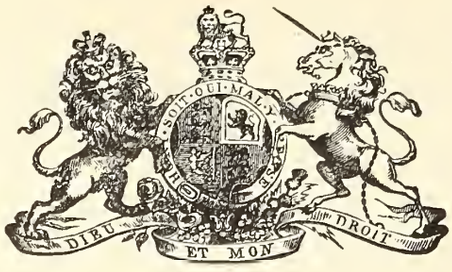
Magnificent fleet of steamers in the inland waters of Southern British Columbia by which all important points, not connected by rail, can be reached.

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PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents anuually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

PROVINCE of QUEBEC

The attention of Miners and Capitalists in the United States and in Europe is invited to the

GREAT MINERAL TERRITORY

Open for investment in the Province of Quebec.

Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at the mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order in Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's Certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end on the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 an acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee $5.00 renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed in the river below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent. on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River and Hill Claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer Claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim, and each person in his or its employment, except house servants, must hold a Free Miner's Certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of five per cent charged on the gross output of the claim, with the exception of an annual exemption of $5,000 00.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek or gulch, but the same miner may hold any number of claims by purchase, and Free Miners, not exceeding ten in number, may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch or river, by giving notice and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00 and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette*.

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, and a royalty of five per cent. on the gross output, less an annual exemption of $25,000.00 are charged. Operations must be commenced within one year from the date of the lease, and not less than $5,000 must be expended annually. The lease excludes all base metals, quartz and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,

Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite : copper in sulphide and native form ; gold, mostly in free milling quartz ; silver, native and sulphides ; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc., apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

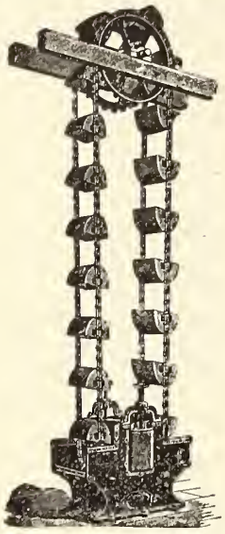
or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

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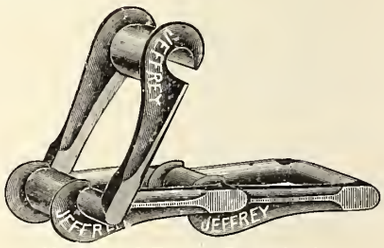
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Any size, shape or capacity.



Chains of Every Descrip ion

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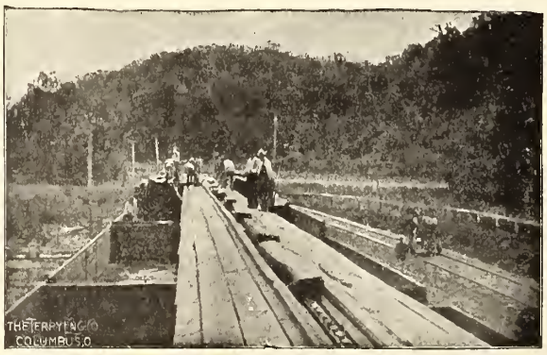
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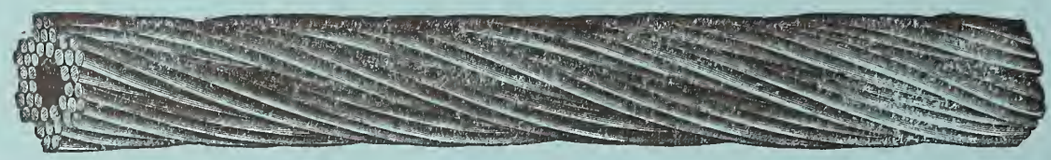
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Vol. XXI—No. V. OTTAWA, MAY 31st, 1902. Vol. XXI—No. V.

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Two Tanks in the Mine—
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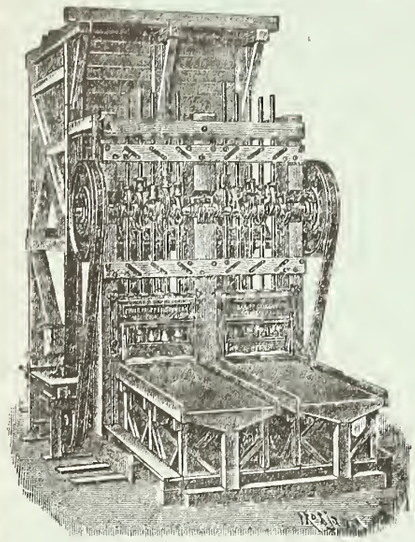
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Complete Gold Ore Dressing Plant

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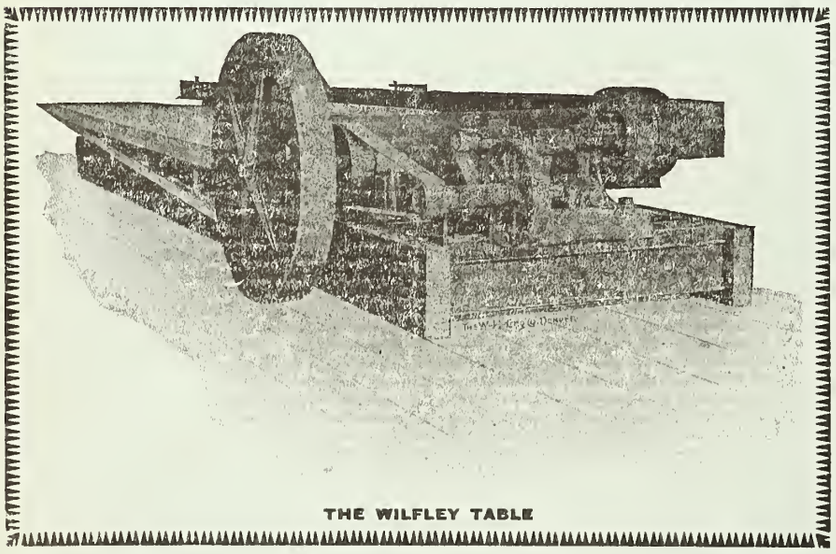
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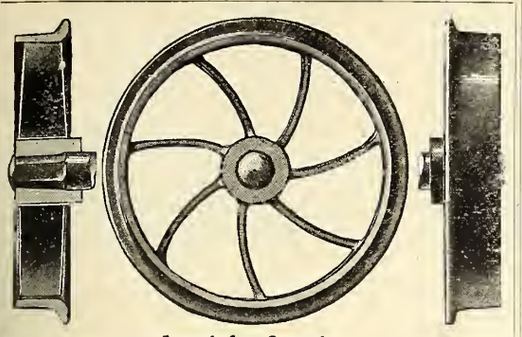


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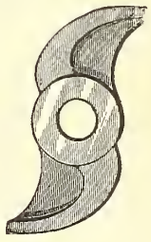


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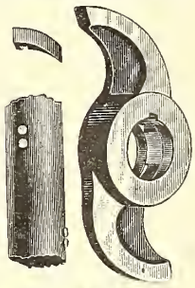


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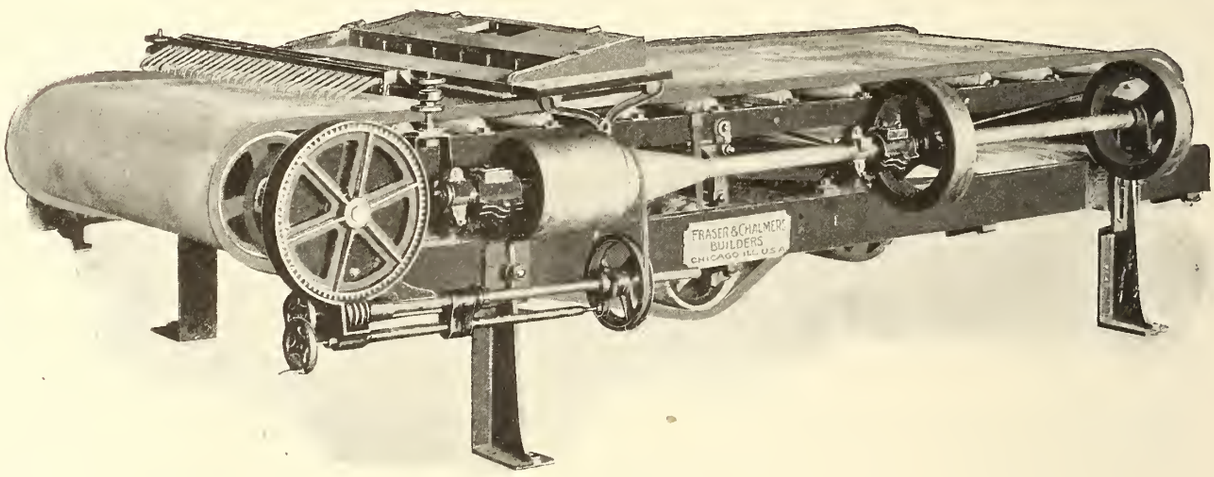
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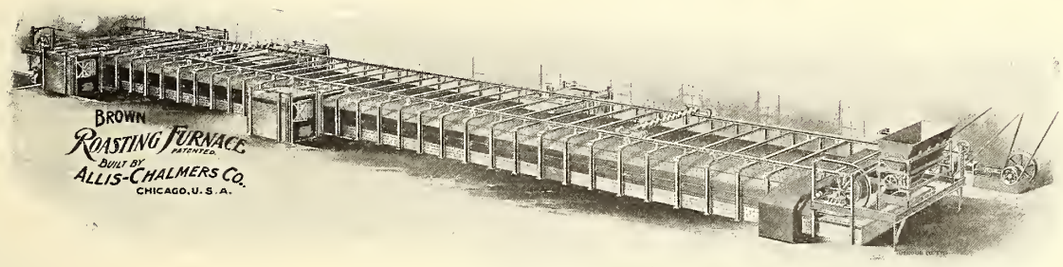
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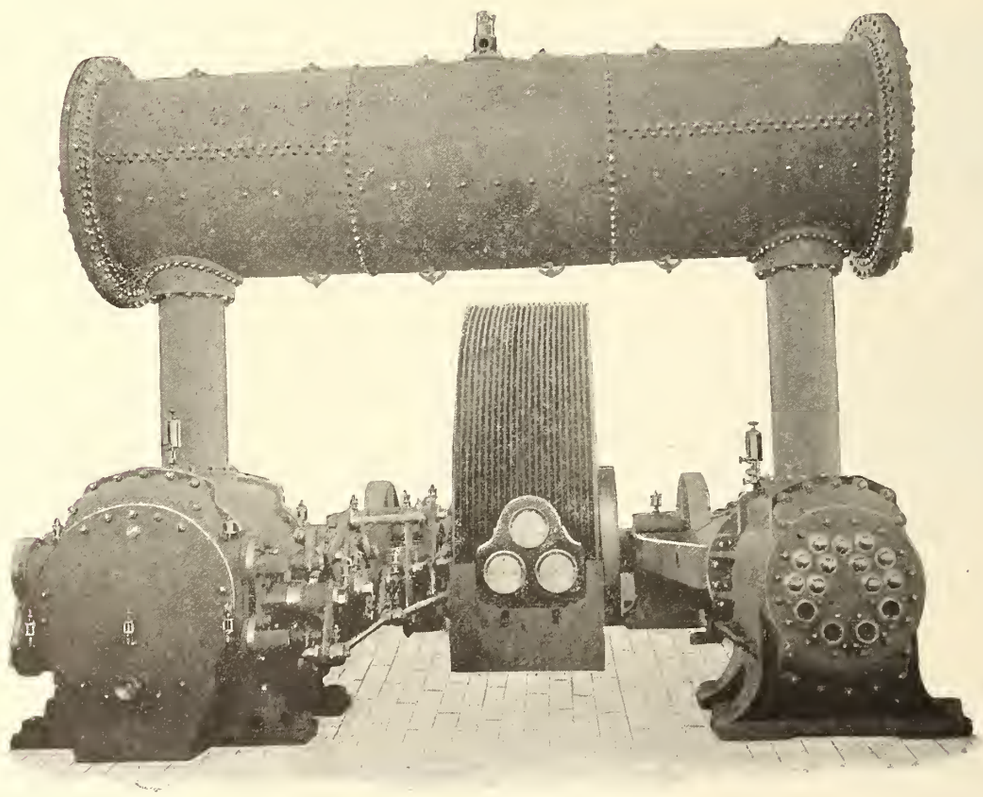
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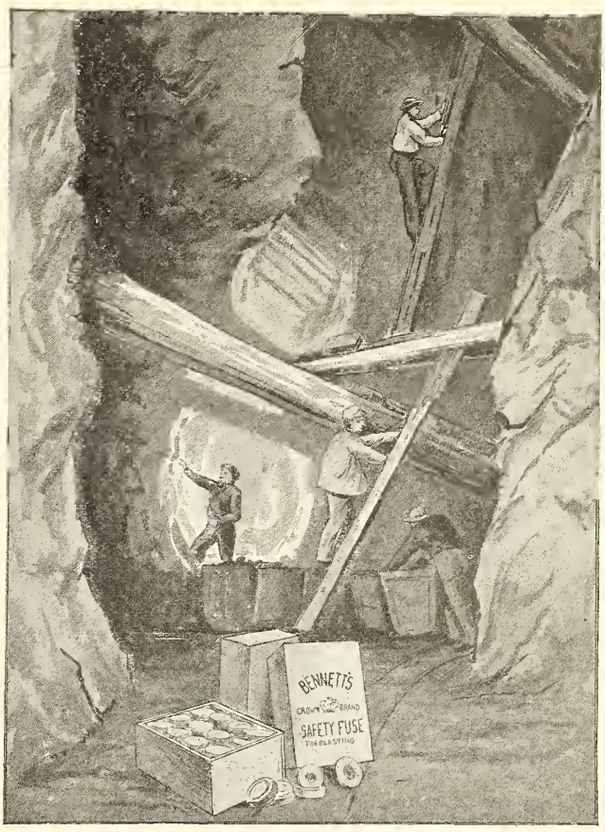
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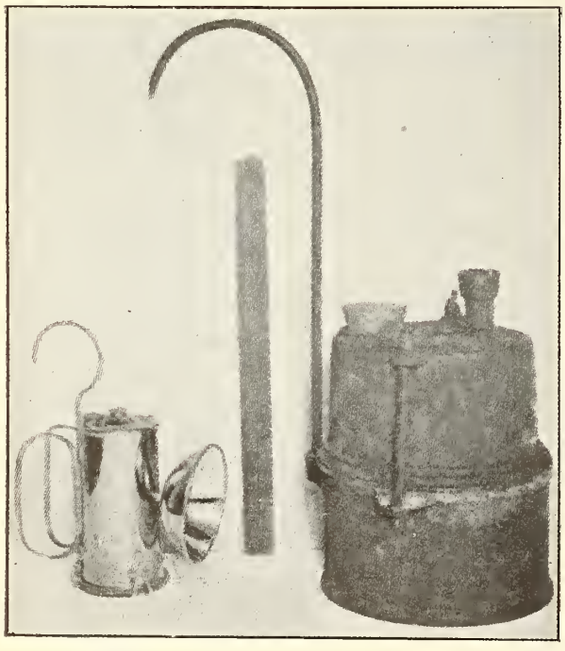
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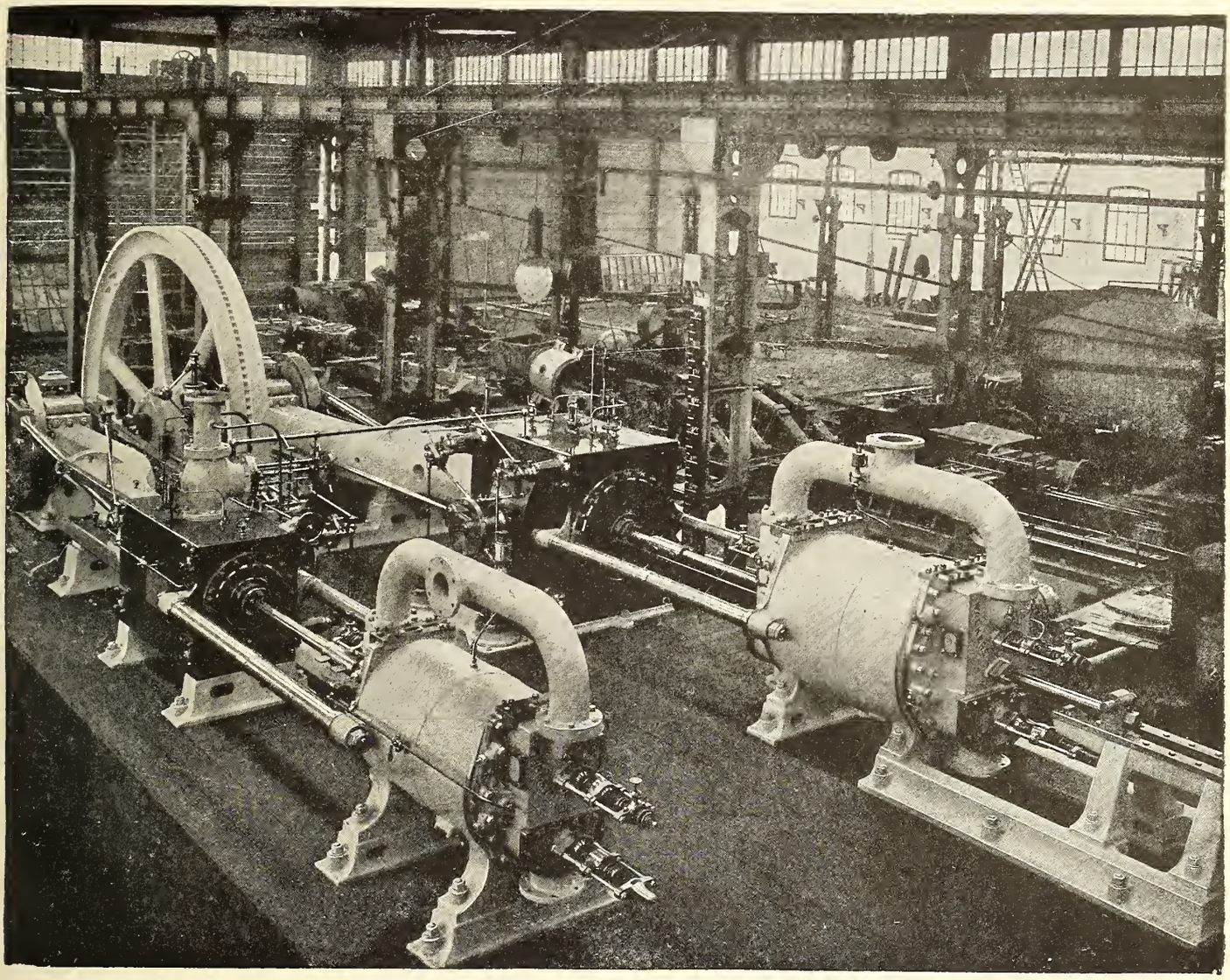
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DEAR SIRS,—We are pleased to confirm what we told you verbally the other day, viz: that we consider the Air Cylinders and Valves of your Compressors to be the best for such work as we have been carrying out on the above Contract.

One of your Engines ran for almost a year without stopping, and it gives us great pleasure to thus testify to the good qualities of the plant which we purchased from you.

We are, Dear Sirs, Yours faithfully. (Signed) pro S. PEARSON & SON, E. W. MOIR.

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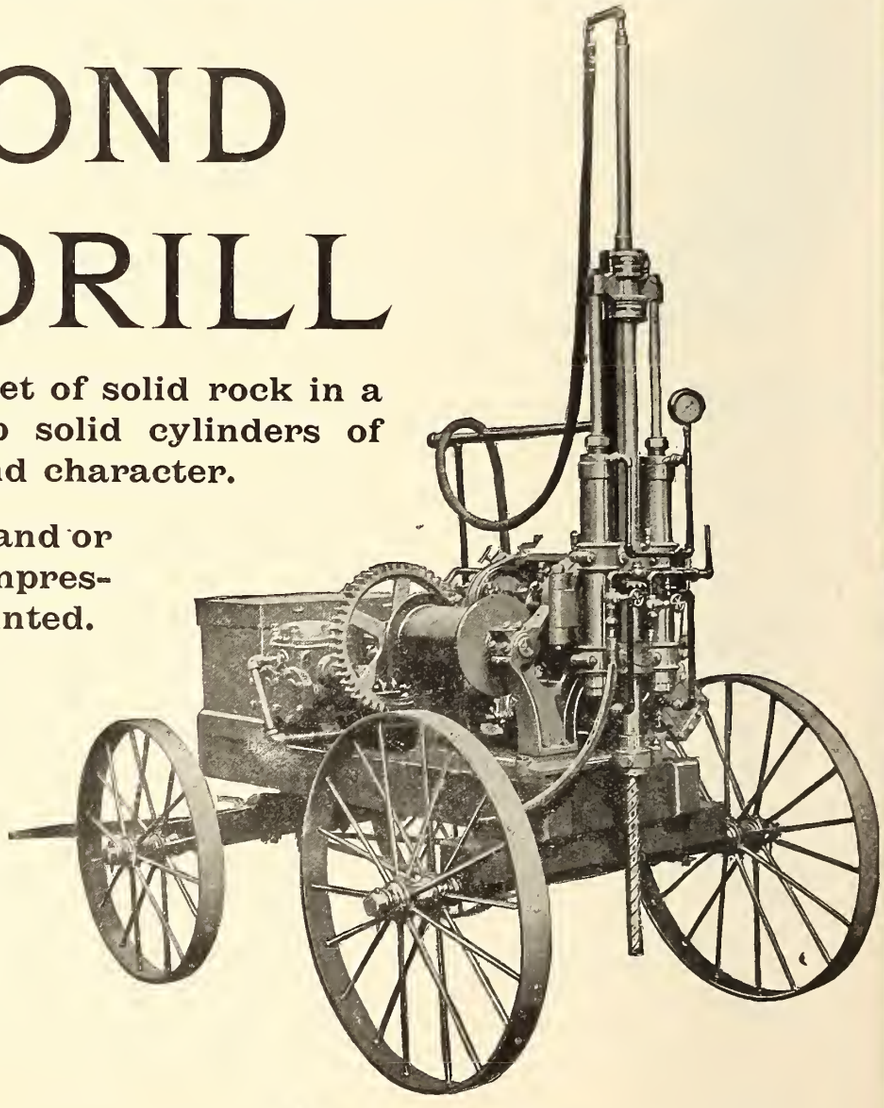
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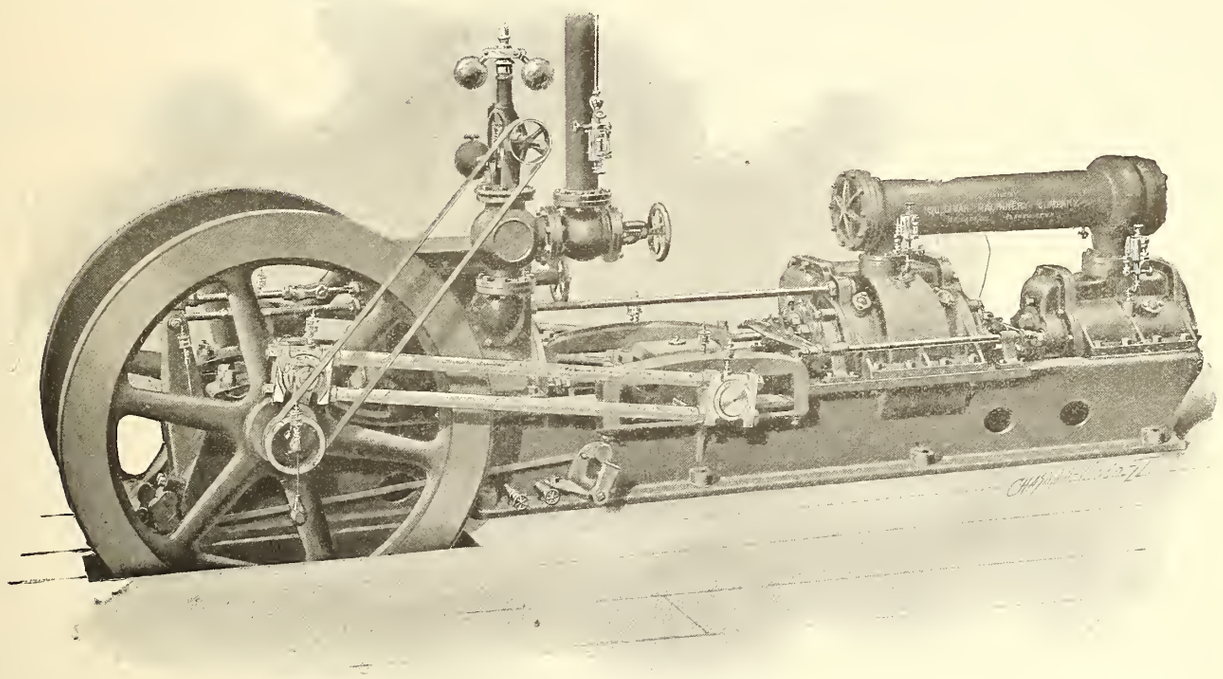
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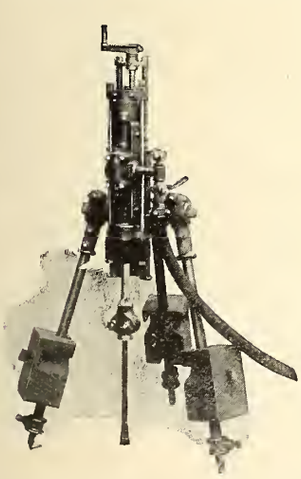
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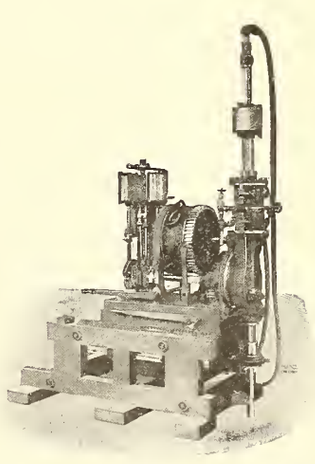


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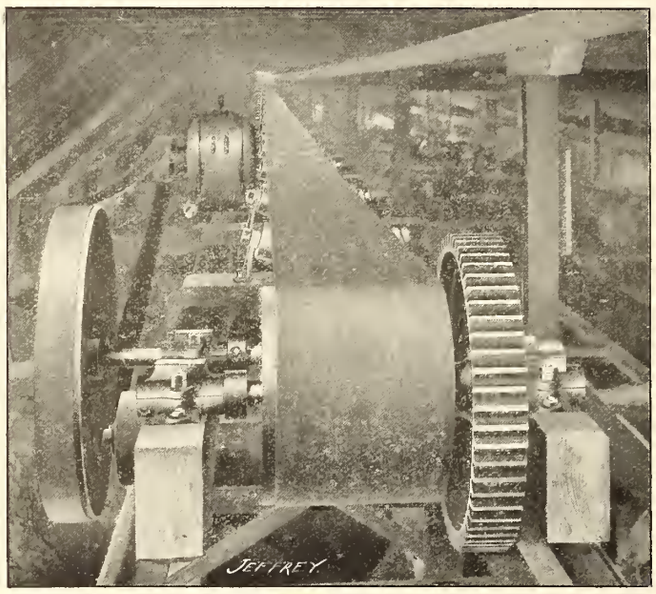
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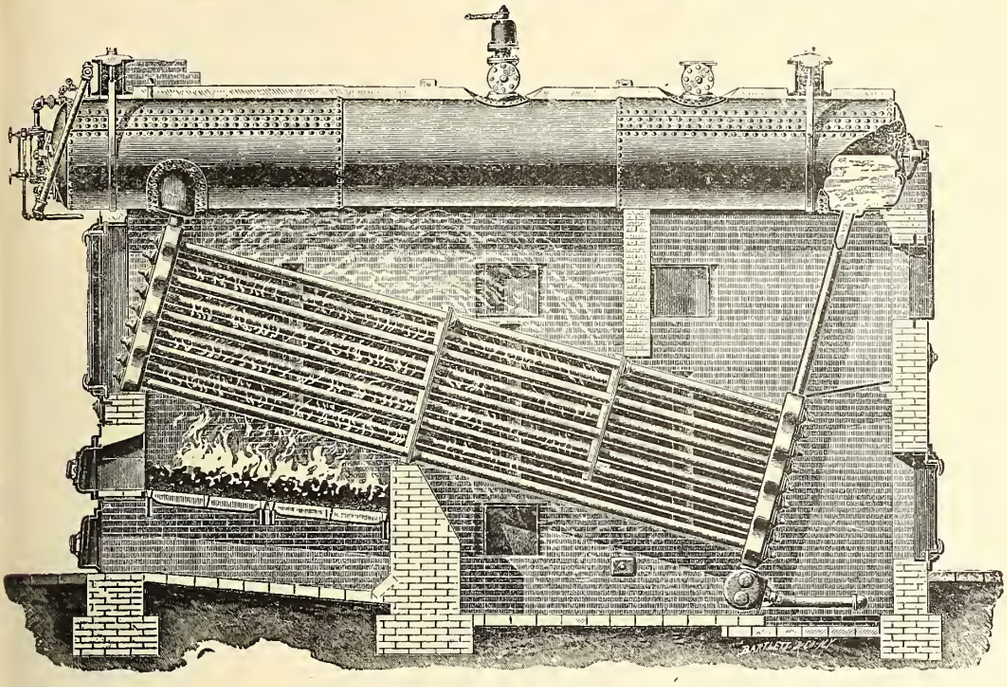
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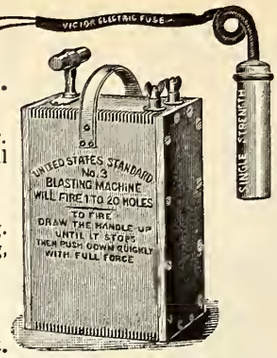
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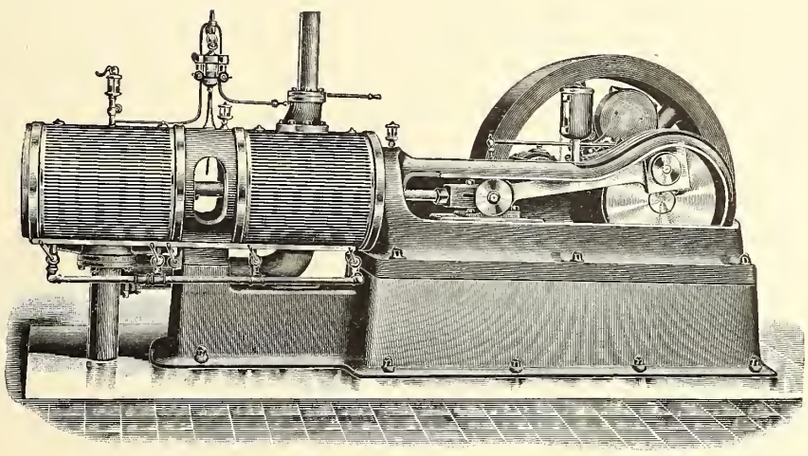
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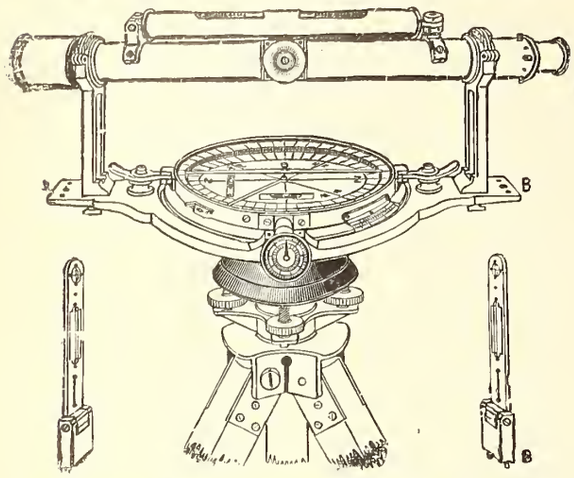
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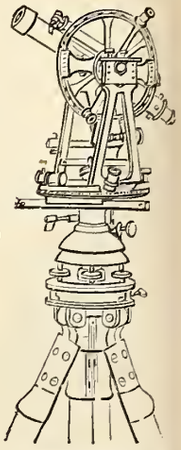
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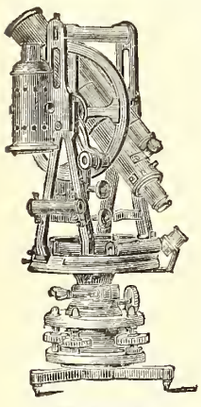
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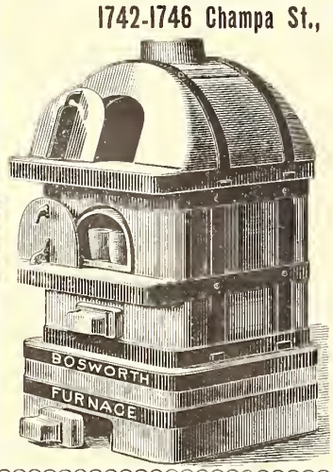
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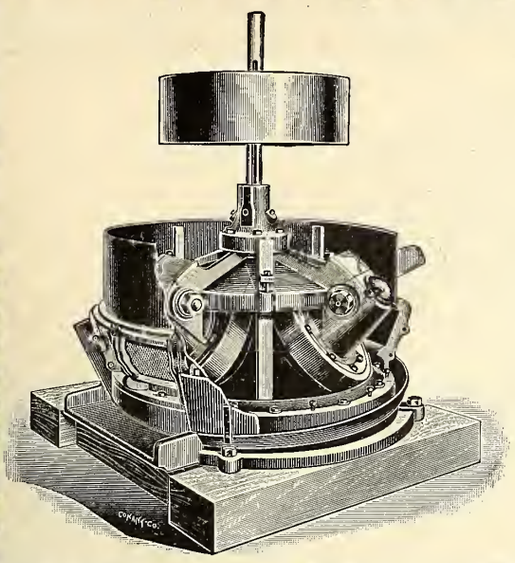
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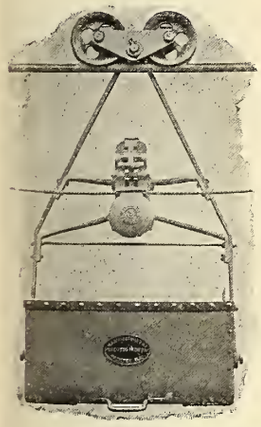
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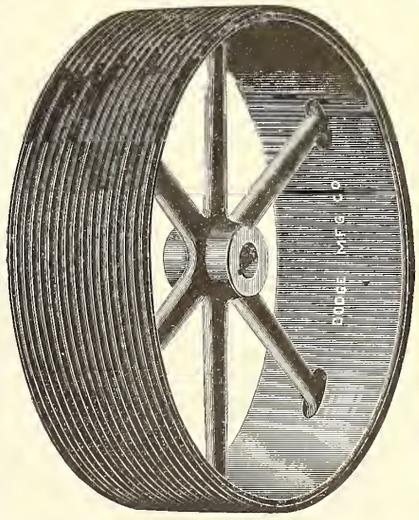
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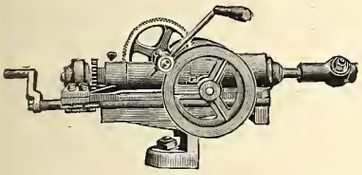
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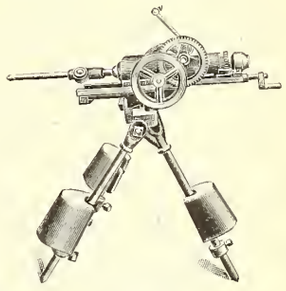
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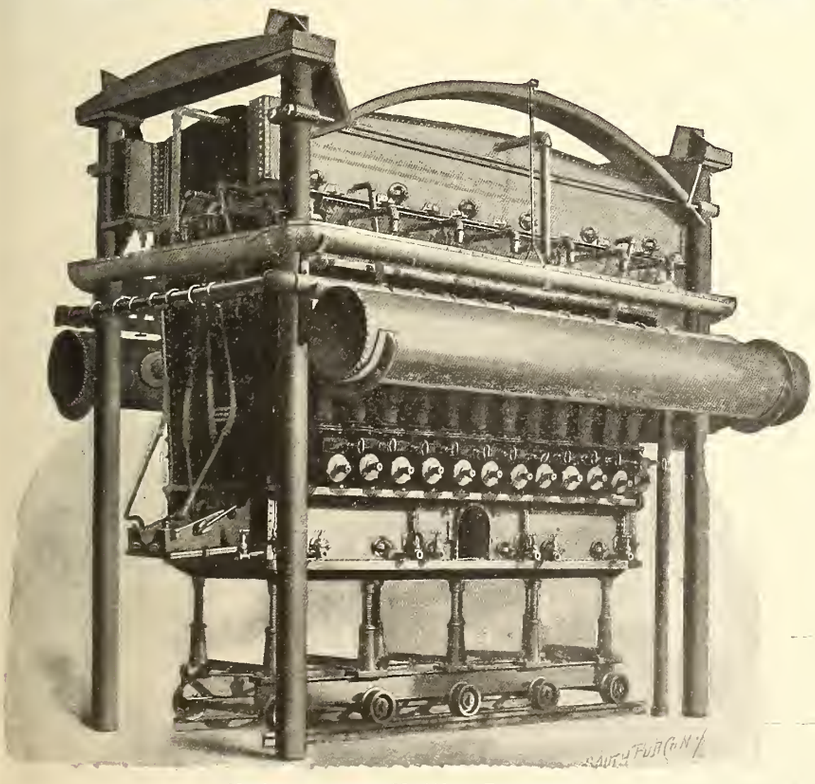
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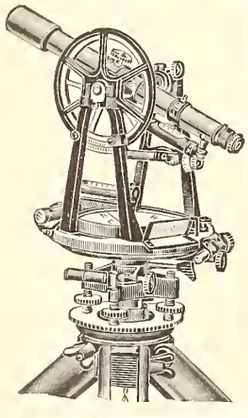
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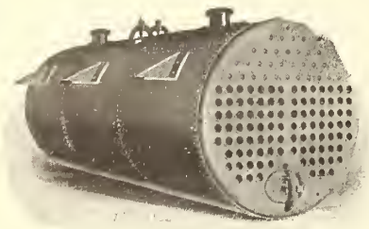
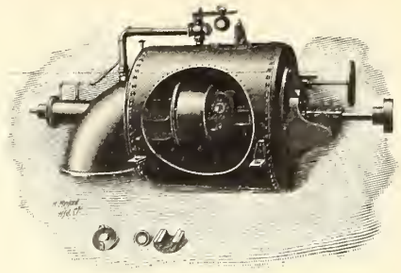
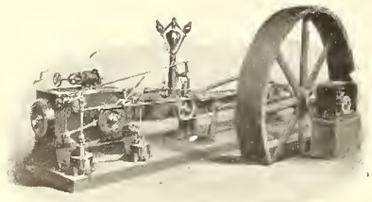
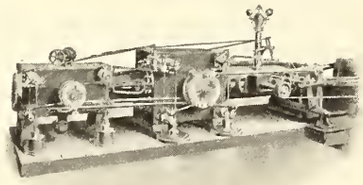
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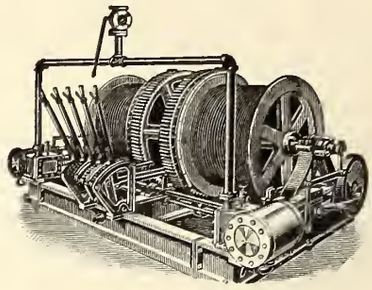
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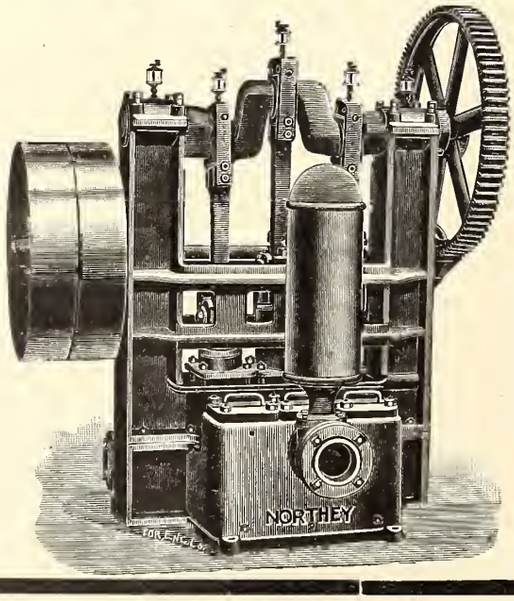
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Some Work for a Department of Mines and Geology.

One feature of industrial progress which was noticeable in the past century is becoming its marked characteristic in the present. We refer to the application of engineering principles to an ever-widening sphere. Large scale enterprises are everywhere taking the place of smaller operations, and the use of mechanical power is continually increasing. The production and use of power in a large way is therefore a problem upon which the engineers of each country must act vigorously, because upon its successful solution depends to a great extent the industrial prosperity of the nation. For example, Great Britain is dependent almost altogether upon her coal, of which she raises some 250,000,000 tons a year. She uses four fifths of this amount and exports the remainder. Professor John Perry calls attention to the extremely wasteful method of using coal in generating steam, and assures his readers that, if a selected body of British men of science devoted their whole time to finding a way for directly converting the potential energy of coal into a form which could be used to drive machinery, the problem would not remain many years unsolved. It would pay to spend several millions of pounds for thus increasing the power of a ton of coal eight or ten fold. But in Canada we have much greater diversified sources of power. While coal plays an important part in the extreme East and in the West, there are great stretches of our country far removed from coal areas, or dependent upon supplies from the United States. Fortunately, as is usual in such cases, nature has not left us without compensation. We still have extensive forests, valuable for their lumber, but also for the power which might be generated from the waste wood. Dr. James Douglas, of New York, in an article in the May number of the REVIEW, describes a modification of the Loomis-Pettibone gas generator, which has been used successfully in generating from wood gas of quality suitable for use in gas engines. The wood is completely converted into this gas (ash of course excepted), which is now being manufactured and used to run gas engines at Nacozari, Mexico. Dr. Douglas believes that very little modification would be needed to adapt this generator to utilize saw-mill refuse. When this improvement is made we shall have at our command a great supply of cheap power, and also a cheap gas which may be used in metallurgical and other furnace work.

But Canada has in greater quantity than other nations a form of power more easily available than this. Nature has distributed water powers throughout the Dominion with an unusually lavish hand. The report of the Ottawa Board of Trade shows that there is within a radius of forty miles of that city available water power to the extent of about one million horse power—enough to make our Capital the greatest industrial centre in the world. For the transmission of water power by electricity is now a familiar fact, and in the form of the electric current it is delivered with little waste and is applicable directly to a great variety of manufactures. It is being recognized more and more clearly that a country liberally supplied with water power has a great and enduring inheritance. The cost of coal increases as the mines grow deeper; but there is nothing of this sort in the case of water power. With a proper system of forest conservation and storage basins, a waterfall or rapid constitutes a practically perpetual source of energy. And just here comes in our suggestion for the Department of Mines and Geology. Canada should advertise her water powers and the manufacturing possibilities attached to them. Two classes of manufactures come in naturally, (1) those depending on raw materials to be found in the neighborhood of the power, and (2) manufactures in which cheap power is the principal factor of success, the raw materials being such as to allow a large margin for transportation. Here, then, is a fine field for investigation:—*A Monograph on the Water Powers of Canada*, their distribution, their accessibility by rail or water transport, their horse power value and its variations, and the possibilities of building up manufactures around them. So far as we are able to learn, no systematic survey of this kind has yet been made in Canada. Hydrography is in its infancy here. We have before us Part IV of the Twenty first Annual Report of the United States Geological Survey—a magnificent quarto of 768 pages, all devoted to hydrography—a survey of water resources in all sections of the United States from the Atlantic to the Pacific. The measurements of surface streams and the estimates of daily flow, underground waters, surveys of reservoir sites, utilization of water for irrigation, power, and other industrial purposes—these are the principal subjects dealt with in this monograph. It is to be noted that most of the results dealt with in the report have been obtained by the assistance of local hydrographers, who made daily observations of rate of flow, etc. The organization is much like that of our meteorological service. Observations were made on 156 rivers, and for each of these the amount of flow of water is shown for at least several months of the year and in many cases for every month. This is valuable information. The height of a fall at a point on one of these rivers being known, the power available during any month in the year for which the flow has been observed can be calculated. A special study of water powers on the Potomac river has been made, and great variations are noted in the amount of flow during different years. These are due to variations in the annual rainfall. As the value of a water power is its *minimum* value, it is plain that the work

of a hydrographic survey, to be complete, must consist of observations extending over a number of years But drainage areas, storage basins, and engineering possibilities of dams, canals, etc , these among other things modify the value of a water power. Such information can be obtained and put on record once for all.

There is an opportunity here for a great service to Canada. It will involve expenditure, but surely no one could be in doubt as to its being a good investment. In Europe the water powers are being eagerly developed and utilized. Italy, like some of the provinces of the Dominion without coal areas, has greatly increased her importations of coal by developing water powers. The investing and manufacturing world should be made aware of the unique resources of Canada in this respect. This can be done in one way only,—by a thorough hydrographic survey of those parts of Canada in which water powers are to be found. It should be begun at once, carried on vigorously and the results published from time to time in a form suitable for wide distribution, leaving the more elaborate description of details for subsequent publication in the permanent form of annual reports.

Chromite and Asbestos in 1901.

The production of these two minerals in the Eastern Townships of the Province of Quebec constitute, as everybody knows, two of the most successful mining industries of the Dominion. The following notes, published in an advance bulletin by Dr. Joseph Hyde Pratt, in the "Mineral Resources of the United States," will be of interest to those of our readers who are engaged in these industries as showing the progress being made in the production of chromite and asbestos across the border:—

Although but little chromite, the source of chromic iron ore, has been mined in the United States during the last few years, some of its recent uses should cause deposits not now worked to become productive. The metal itself, chromium, is not used directly in the arts. The mineral chromite is used in the manufacture of brick for basic open-hearth furnaces. In one furnace over 400 heats were turned out before the chromite brick lining had to be replaced, Chromite has been successfully tried also as a hearth lining for water-jacket furnaces in copper smelting; and its merits are that it is infusible, that it does not become friable when heated and cooled, that it is not affected by sudden heating and cooling, that it is not attacked by the products formed in the fusion of the copper ore, and that, being so hard, it wears away very slowly under the flow of the fluids over it. It has been thoroughly tested at the Elizabeth Mine, at Stratford, Vt., and is about to be tried at the Ducktown furnaces at Ducktown, Tenn. Dr. Pratt thinks this use should produce a demand for the chromite ores of North Carolina, which would be available for the smelters in the Virgilina copper district of Virginia and North Carolina, the Ore Knob and Gold Hill copper districts of North Carolina, and the Ducktown district of Tennessee. The chromite deposits of California should, in the same way, become available for the same purpose in the copper districts of Arizona, Utah and Montana.

The principal use of chromium as an alloy is as the ferro-alloy, used with ferro-nickel very largely in making chromic steel for armor plate and armor plate piercing projectiles, for trolley-car wheels, crusher jaws, stamp mill shoes, safes, etc. Chromium in the presence of carbon makes steel intensely hard. The ferro-chromium alloy has to be produced under intense electric heat from high-grade ore low in silica; and one of the largest companies manufacturing the ferro-chromium is the Wilson Aluminum Company, whose works are located at Holcombs Rock, Bedford County, Va., and at Kanawha Falls, Fayette County, W. Va, where there is abundant water power for the production of electricity.

The chief use of chrome is in the production of chromate and bichromate of potash, and as coloring pigments in producing shades of buff, red, brown, aud black in the manufacture of textiles, pottery, etc.

By far the greater part of the chromire used in the United States is brought directly from the deposits of Asiatic Turkey. The New Caledonia deposits are beginning to be worked to some considerable extent; the Canadian chromite deposits in the Black Lake region of the Province of Quebec, and the deposits of Bluff Head, on Port au Port Bay, west coast of Newfoundland, are also producing.

The value of chrome ore depends upon its percentage of chromic oxide. The standard ore contains 50 per cent. of oxide, and increases in value from 75 cents to $1 per ton for every unit above 50 per cent., the price decreasing in much greater proportion for every unit below 50 per cent.

Since 1896 there had been scarcely any production of chromite in the United States, until 1901 when California produced 368 long tons, valued at $5,790. The imports of chrome ore in 1901 were 20,112 long tons, valued at $305,001, as compared with 15,793 long tons, valued at $284,825, in 1900. The domestic production will probably increase considerably in the immediate future.

Asbestos.—Two distinct minerals are mined and sold under the name of asbestos; one, a silicate of calcium and magnesium, is a variety of amphibole, and the other, a hydrous magnesium silicate, is a variety of serpentine known as chrysotile. They are equal in their heat-resisting qualities; but the chrysotile variety is the superior in strength and elasticity of fibre, and therefore commands a wider market. The chrysotile fibres are short, varying from half an inch to two and a half inches in length; amphibole fibres have been found that were three feet long. Amphibole asbestos occurs in quantity in several localities; but at the present time the Sall Mountain deposits at Santee, 12 miles northwest of Clarksville, White County, Ga., are the only producers. A new deposit, which promises well, had been developed at Northwest, Habersham County, Ga.; and on Tryon Mountain about one and a half miles west of Skyuka, Polk County, N.C., amphibole asbestos has been found in a series of pockets. A promising occurrence has been found in Bedford County, Va., about 12 miles southeast of Bedford City.

Known deposits of chrysotile asbestos are few, at the present time the only ones being those in Canada, Vermont, Wyoming and California. Practically all the chrysotile asbestos, used in this country and Europe, is obtained from the deposits at Black Lake and Thetford, near Sherbrooke, Quebec, Canada. The mining is by means of open quarries. The new uses and the consequent constantly increasing demand for chrysotile asbestos should result in the enlarged production of this material in the United States in 1902, the year 1901 having been what may be called a year of development work. The Vermont deposits are located in the northern central part of the State, on and near Belvidere Mountain, in the towns of Eden, Lamoille County, and Lowell, Orleans County. There are four companies operating in this vicinity: the New England Asbestos Mining and Milling Co., on the south side of Belvidere Mountain; the National Mining and Developing Co., on the south-eastern side of the Belvidere Mountain; the Tucker Asbestos Co., on the eastern slope of Belvidere Mountain, all in Lamoille County; and the Vermont Asbestos Co., two miles northeast from Lowell Village, in Oreans County. The mining here also is by means of open quarries. The Wyoming deposits are in the vicinity of Casper, Natrona County, and they are now being thoroughly developed by the McConnell Asbestos Co., of Pittsburg, Pa. A number of

other asbestos properties are being developed by various persons in this same general neighborhood. In California asbestos mining during 1901 was confined to the deposits in Riverside County, operated by the Pacific Asbestos Co. An asbestos prospect has been developed between Greenwood and Georgetown, El Dorado County; also in Calaveras County, in the vicinity of Copperopolis, the Elva asbestos mine has been developed to a limited extent. Chrysotile asbestos has been mined to a limited extent by the Berkshire Talc Mfg. Co. in the town of Hinsdale, Berkshire County, Mass. Chrysotile asbestos is reported also as having been found in the Upper Apple Gate district, near Grants Pass, Oregon, near the Oregon-California boundary; in the Enchanted Lake region west of Sims Station and near the line between Trinity and Shasta Counties, California; and near North Wilkesboro, Wilkes County, North Carolina. Both kinds of asbestos are used where non-conductivity of heat is the important factor, but it is the chrysotile variety that is used in the manufacture of cloth, rope, felts, buckets, tubs, washers, and so on. The production of asbestos in the United States during 1901 amounted to 747 short tons, valued at $13,498, as compared with 1,054 tons, valued at $16,310, in 1900, and 681 tons, valued at $11,740, in 1899. The imports of asbestos in 1901 were valued at $691,828, as compared with $355,951, in 1900. The Canadian asbestos product in 1901 was valued at $1,186,434, as against $763,431, in 1900.

The Consolidated Lake Superior Company.

In answer to enquiries by readers, we are in a position to give the following authentic particulars concerning this enterprise, popularly known as the Clergue Syndicate, operating at Sault Ste. Marie, Ont.:

A. The Company was incorporated under name of the American Lake Superior Power Company, on 17th April, 1897. The name was changed to the present title July 7th, 1898, and the charter amended May 17th, 1899, and May 3rd, 1901.

B. The capital comprises $82,000,000 Common stock, of a par value of $100, of which, at 30th April, 1902, $68,000,000 had been issued; also $35,000,000 7 per cent. non-cumulative Preferred stock of a par value of $100, of which, at 30th April, 1902, $20,000,000 had been issued.

C. The names of the Directors are:—E. J. Berwind, H. A. Berwind, Wm. L. Bull, James Butterworth, F. H. Clergue, E. V. Douglas, W. P. Douglas, J. S. Freeman, Lynde Harrison, E. C. Lee, F. S. Lewis, Chas. E. Orvis, George Philler, S. M. Prevost, Samuel Rea, T. C. Search, James S. Swartz.

D. The names of the Officers are:—E. V. Douglas, *President*; F. H. Clergue, *Vice-President and General Manager*; F. S. Lewis, *Treasurer*, and W. P. Douglas, *Secretary*.

E. The head office of the Company is located in the North American Building, Philadelphia, and the Canadian offices are at Sault Ste. Marie.

F. It controls through stock ownership:—

1. The Lake Superior Power Company, organized under the laws of Ontario, in 1895. Capital stock, $500,000 preferred; $1,500,000 common.
2. The Michigan, Lake Superior and Power Company, organized under the laws of Michigan, in 1897. Capital stock, $500,000. Bonded debt, $3,500,000, 5 per cent. fifty year bonds, secured on the development of water power on the Michigan side.
3. The Sault Ste. Marie Pulp and Paper Company, organized under the laws of Ontario, in 1893. Capital stock, $750,000 preferred; $1,250,000 common stock.
4. Tagona Water and Light Company, organized under the laws of Ontario in 1895. Capital stock, $200,000. Bonded debt, $100,000, twenty-year 5 per cent. bonds.

Through the acquisition of these companies and of other properties and franchises, the Company possesses the following assets:

a. Lands and water power rights at Sault Ste. Marie, Mich., sufficient for development and operation of mechanical energy to the amount of 60,000 horse power. The canal, power station and installation of machinery, in connection with these developments were completed in May, 1900. The Union Carbide Company of New York and Chicago has leased one-half of the above power for twenty-five years, at an annual rental of $200,000, which it is stated will pay the interest on the bonds and all operating expenses, leaving as profit the revenue from leases of the remaining power, amounting to $275,000.

b. Lands and water power rights at Sault Ste. Marie, Ontario, controlling mechanical energy estimated at 100,000 horse power, of which about 20,000 has been developed by means of a canal and power house. Three-fourths of this power is used by the Sault Ste. Marie Pulp and Paper Company, and the other 5,000 by the Nickel Steel & Reduction Works.

c. Pulp mills of the Sault St. Marie Pulp and Paper Company, which are producing over 100 tons per day of dry ground wood pulp, and yielding an annual net profit of about $150,000.

d. Machine shops and foundry equipped for the manufacture of pulp, and paper mill, hydraulic mining, smelting and electrical machinery. The net earnings of these works in 1898 were $35,000, and new buildings have since been added to meet increased demands.

e. Nickel mines, located in the Sudbury nickel renge, in Canada. It is reported that the opening of this mine shows a large supply of very rich ore. The company is beginning the manufacture of nickel steel, by a process which it controls, and is reported to have a contract with the Krupp Gun Works to take, for five years, all the nickel steel of the Company, up to 250 tons daily.

f. The "Helen" iron mine, located about 12 miles from Michipicoten Harbor. A company controlled by the same interests and known as the Ontario Lake Superior Company, was organized in 1899 to construct a railroad through this region.

g. A sulphite pulp mill, just completed, for the manufacture of long fibre pulp. A sulphuric acid plant, for manufacturing sulphuric acid from the sulphur produced by the Sudbury ores. A laboratory for testing, chemically and electrically, raw materials and products.

h. The Tagona Water and Light Company, supplying water and light to the town of Sault Ste. Marie, Ont.

i. By contract with the Province of Ontario, the Company owns a grant of timber, equivalent to the growth upon 1,000 square miles of virgin forest.

In June, 1901, the Company was consolidated with the Ontario Lake Superior Company, the preferred stock of the latter company received 125 per cent. in new preferred stock of the Consolidated Company and the common stock of the Ontario Company receiving 200 per cent. in the common stock of the Consolidated Company. At the same time the old stockholders of the Consolidated Company received in exchange for their holdings the same percentage of new shares. The steel business of the company is carried on by the Algoma Steel Company, Ltd., with plant at Sault Ste. Marie.

The following estimate of earnings of the Consolidated Company has been given out by the management:—

> "20,000 hydraulic horse power canal on Canadian side, $200,000; Tagona Water and Light Co., $16,000; mechanical and sulphide pulp mill, $750,000; steel works (to be finished Aug. 1, 1901), $400,000; ferro-nickel works (100 tons daily), $450,000; nickel ores from company mines, $75,000; sulphuric acid by-product of nickel ores, $20,000; merchandise sales of iron ores, 800,000 tons at $1.25, $1,000,000; 90,000 cords of pulp wood, $90,000; sales of timber to outside parties, $150,000; Algoma Iron Works, $100,000; railroad operations, $479,000; lake operations, $160,000; Government bounty on 75,000 tons manufactured steel, at $4, $300,000; Government bounty on 36,000 tons manufactured ferro-nickel, at $4, $144,000; total net income, $4,334,000. On this basis the earnings would be sufficient to pay the preferred dividends and leave a surplus of about 3 per cent. for the common stock."

Concerning the mining operations of the Company, Mr. W. P. Douglas, Secretary, writing under date of 9th instant, advises:—

"We are now shipping ore from the 'Helen' iron mine at Michipicoten, our shipments for the month of April being in excess of 62,000 tons, and we anticipate an output equal, if not in excess of this for each month of the present navigation season. We are also mining nickel ore at the 'Elsie' mine and 'Gertrude' mine, raising at the present time about 400 tons per day. A portion of this output is sent to our ferro-nickel plant at Sault Ste. Marie, Ont., to be desulphurized and made into briquettes, which will be used in our steel works for the manufature of nickel steel. The balance is roasted near the mines and made into nickel matte."

The Law of Compensation for Injuries to Workmen.

The prevention of what are called "accidents," resulting in loss of life or limb in mines, may be said to be a progressive subject. "The quarry slave at night scourged to his dungeon" and the "slave of the dark and devious mine" may yet be found at work for the prison contractors of Tennessee or where the victims of Russian despotism groan under Siberian rigors. It would be necessary to go back so long ago as nearly a century to find among women and children working in English coal mines the victims of barbarities not less cruel than any which some cannot read without tears and sickness of heart. The moral arithmetic of mankind is of ever-widening scope and universal application. All moral problems become questions of cost, and conversely every question of cost involves a moral factor or X. Cheaper illumination is without blush recognized as the vindication of the schemes by which men crush or freeze out their neighbors to obtain monopoly. Cheaper transportation seems likely to make Sir Georgias Midas Lord High Admiral of the Seas, and may soon obliterate the legend that "Britannia rules the waves." The value of human life must find its place in all the plans by which these great schemes are kept moving. The mangled limb must be paid for, somehow—even should the man beg; and the disabled laborer knocks at the door of a Friendly Society to get his weekly insurance The widow and orphan are kept from the poor-house by an insurance on the life of their breadwinner. But the Courts are occupied every trial session with cases in which the liability of the employer is under review, and the questions at issue are fought by employers with a great deal of vigor, much to the benefit of the legal profession and the discomfiture of those who have to add to the rankling sores left by loss of limb or the poignant grief which follows the loss of a bread-winner, upon whose life depended a livelihood, that other burden grievous to be borne that the law—the impersonation of the society and fellowship of mankind—gives no redress

It is not far to seek the causes of the failure of litigation for compensation for injuries to workmen. First, there is the class-consciousness of some judges whose conservatism will not reach a decision which will declare what ought to be where ages have given sanction to what is, and with whom the word "accident"—a word of no scientific import—is a logical process to conjure with for the solution of any difficulty which befogs their own minds. Second, there is the influence which the employer of labor, if a capitalist or a company, has over a community by patronage and character—an influence effective or not according to the intelligence and independence of the community from which the jury is drawn. Third, the skill of the counsel engaged, which is generally in proportion to the fee, and which usually places the heavier artillery at the command of the mine owner. A fourth cause might be ascribed to the inefficiency of the mode of trial, which is a "strife for triumph more than truth." The residue of diabolism in a large number of civilized men works against any confession that they may be wrong-doers in requiring men to work under dangerous conditions where the contract of hire and labor is apparently purely voluntary on both sides—so voluntary that the miner is in many cases obliged to accept the hazard rather than starve. The employer recognizes no duty to put himself in the workman's place, and knowing no responsibility for the man's poverty sees no moral obligation to make any compromise of the terms which compel the employed to submit to the condition of a mine without complaint. The hardship of the miner is very often a personal matter for which he is not responsible. He may be more reckless, less intelligent or slow-witted than the men who escape injury. Such infirmities should be clearly taken into consideration in any fair legislation for securing to workmen compensation for injuries. For example, a boy under the age of legal contract of hire is employed in a mill, and during the working of a machine sees a piece of the machinery out of gear. To put it in order he impulsively tries to avoid what he thinks is an impending danger to the machine, and has his arm taken off in the attempt. Here is clearly a case in which the law against labor contracts with minors should make liable the employer for the injury to the boy, the Act having been framed partly with a view to prevent injuries to youth of insufficient experience. An employer is clearly under no obligation to expose himself to the risk which attends the employment of persons of insufficient capacity; if he does so expose himself, he cannot complain if he runs the risk of having to pay a penalty. This position opens a wider question of liability than that which is involved in the mere doctrine of Torts. It is notorious that many injuries to, and loss of life among, workmen are due to causes which exclude any charge of culpability upon the employer or of carelessness on the part of the workmen. The injuries are not accidental, though the causes cannot be looked for by the aid of ordinary intelligence. Yet, is it within reasonable probability that the injuries under consideration would not have occured out of the business where they happened? In such case the employer should be liable to make reasonable compensation; and such in fact was the argument of the Marquis of Salisbury when defending the English "Workmen's Compensation for Injuries Act" in the House of Lords against the attack of the coal barons. His argument was, in brief, that in this complex social system of ours those who conduct enterprises in which the lives and limbs of men are exposed to injury should be compelled to undertake a reasonable amount of insurance against loss. Accordingly the limit of compensation for complete disability was fixed at three hundred pounds sterling.

A large part of the duty which is inherent in the constitution of society is mutual protection. The modes, expedients, makeshifts, laws and artifices by which this is attained are innumerable. The evasions of this system which underlies the whole conduct of life are wonderful. The measure of a man's value is inwrought in every deed under the sun. A railway is allowed by law to construct level crossings along the highways, and a number of human lives are yearly sacrificed with as much certainty and as little ceremony as if this were a necessary and inevitable coincidence of our system of internal transportation. The protection which society affords against this wrong is looked at differently in England and in Canada. Argue against the wrong with an American railway president and he will discuss it as a matter of cost. There are old mining captains who declaim against Government inspection of ladders and hoisting gear, and who look upon the examination of their works by Inspectors as unwarrantable interference. In a recent case a miner lost his eye-sight by a blast. The charges fired by the foreman had been all regular. It was shown, however, that the magazine box had been unlocked for days, the key having been lost. There being no evidence to connect the unlocked magazine box with the injury the judge ruled there was no "evidence of any defect in the condition or arrangement of the ways, works, machinery, plant, buildings or premises," by which the injury was caused, and that in fact the injured man was bound to show how the dualin got into the mine. A few weeks after the trial of the cause the employer of this blinded man was working in his own mine in which the "defect in the condition or arrangement of the ways,

works, machinery, plant and buildings" was a plank placed on the bank of the pit in such a way that with a slight movement of the spoil on the bank the plank was sent sliding into the pit and killed him.

Every man employed in a mine should have a reasonably safe place to work in. The conditions which render it unsafe should be at the charge of the employer, and any injury arising in the operation of the mine not due to the workman's own carelessness should be matter for compensation. In settling compensation judges should not have the power to alter the finding of juries. In cases of error on the part of judges, as where their decisions are over-ruled, there should be no costs to either party. With the amendment of the law in these particulars there would be greater care on the part of mine owners, engineers and bosses. Mining would be rid of some of its terrors for a large class of laborers, and instead of burdening the mining industry of the country as it now is with the cost of the lives and limbs yearly lost, there would be such greater care and foresight that mining would cease to be a hazardous occupation. Nothing is gained by the niggardliness which economizes at the expense of life. Every life must be paid for by society. The price of gold is fixed by the cost of actual production plus all the money the fools expend whose mines earn no dividends. That is the true economic science which diminishes every loss, be it in dollars, limbs or lives, to increase the gains. The most costly and foolish extravagance the mine managers of the country can indulge in, is the neglect of the precautions that humane and skilful men will use to insure safety. "Vice is miscalculation" said Bentham. The converse holds good in the subject under review:—"Miscalculation is vice," nay more, it is crime.

Copper Production in New Brunswick.

Within the past couple of years an important and promising copper mining industry has been established near Dorchester, in the Province of New Brunswick, by the Intercolonial Copper Company. This company, whose works form the feature of our illustrated supplement this month, is a syndicate of Providence, R. I. people, organized in 1899, under the laws of the State of Arizona, with an authorized capital of $2,500,000 in shares of $10.00. The mining property comprises three square miles of territory held under twenty year lease from the Government of New Brunswick, and the mines are located at a point about two miles from the town of Dorchester. During 1901, it was estimated that ore of a value in excess of $100,000 was mined, although the efforts of the management were principally directed to development and the installation of plant. The underground works comprise three shafts, down at date 30 feet, 40 feet and 125 feet respectively, two tunnels driven 400 feet and 1400 feet and various drifts, crosscuts, etc., aggregating about 7,500 feet. The mining plant comprises two Ingersoll-Sergeant compressors and an equipment of Ingersoll drills, four boilers, two 125 h.p., one 75 h p., and one 40 h p., double drum hoisting engine, Barr & Knowles steam pumps etc. At the reduction works there are two mills 128 x 80 feet and 110 x 60 feet respectively, and the electrolytic building is 60 x 30 feet. The power for the machinery is generated from two large boilers capable of developing 250 h.p. These are of the latest type with all modern improvements attached. One large engine is utilized for driving the electrical plant for lighting, and also two 50 volt generators for the electrolytic process. A Laurie-Corliss engine supplies the power for the screens, crushers, rolls, elevators and conveyors. The ore, which comes into the shed by gravitation, passes to a Buchanan rock breaker which grinds it to the size of hazel nuts and finer. From the tail of the breaker it goes into an elevator which carries it to the screen where the finely powdered ore passes through into the conveyors and is deposited in the storage bins. The coarse ore falls through a shute to a set of ore rolls made by the George V. Cresson Company, Philadelphia, Pa., where it is ground to a fine powder and then sent through the screen and carried to the storage bins for treatment. The storage bins have each a capacity of 175 tons. From these the ore is carried by fifteen worm conveyors to the dust chamber, whence it is forced by means of fifteen scoops into the retort tubes where the ore is roasted. These retorts are each heated by a separate fire and are kept at nearly a cherry-red heat. They are 14 feet long, 16 inches in diameter and of cast iron. The retorts are fitted with flanges and make five revolutions per minute. The roasting of the ore is to expel the sulphur, and at the same time to convert the copper sulphide into oxide. This is done by heating the ore in the retorts to redness in the presence of the oxygen of the air with which the sulphur unites to form sulphur dioxide, and the copper combines with the oxygen from the air to form the oxide. The sulphur dioxide gas is drawn off from the retorts, collected and compressed to be utilized in the manufacture of sulphuric acid, which is employed in the extraction process. The gas, however, from the retorts always carries a fair percentage of dust, and to remove this it is passed through several flannel gas filters. The machinery of the roasting plant and also the conveyors to the lixivating tanks is driven by a Leonard ball-bearing engine.

The roasted ore passes into a conveyor which carries it to the lixivating tanks. The tanks are built of wood, lined with brick, and have a filter bed of stone, covered on top with cheesecloth. At the bottom of the tanks there are lead pipes to convey the clear extract to the settling tanks. In the middle of the tank there is a large pipe with an outlet and valve attached. This is utilized for disposal of the worthless residual sand. The circular tanks are 20 feet in diameter and 7 feet deep. There are 3 at present with a capacity of 100 tons, or 9000 gallons. The finely powdered roasted ore is placed in the lixivating tanks and covered with a diluted solution of sulphuric acid which converts the copper oxide into copper sulphate. To aid in dissolving out the copper heat is applied by means of steam pipes. The sulphuric acid solution soon becomes blue, the characteristic color of the copper sulphate, and after sufficient time has elapsed the copper solution is drawn off through the lead pipes at the bottom of the lixivating tank to the settling tank. The residue is then washed with water to remove any copper sulphate adhering to the powdered residue, and the wash waters pass to the wash-water tank. The lixivating capacity is at present 250 tons per day. The valve in the lixivating tank is then opened and the worthless residue of sand and mud is flushed out into the big gulch at the side of the works.

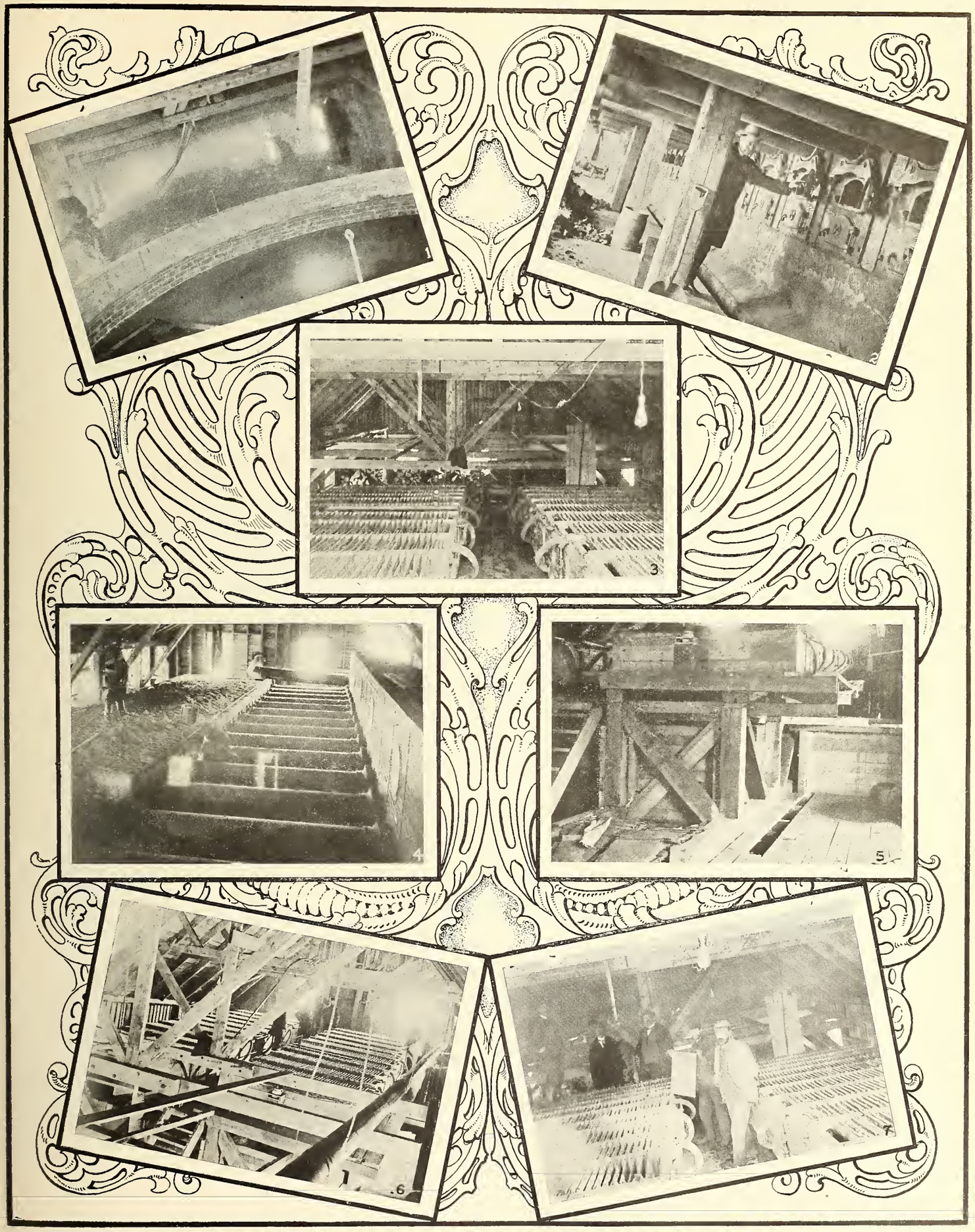
In the electrolytic building there are 22 precipitation cells, at present constructed of wood and lined with lead. These cells are arranged on a slope and the copper solution passes from the upper to the lower. The electrodes are both of lead and connected with the electrical generator in the power house The copper is deposited from the solution upon the cathodes which are made of lead, 22 x 26 inches. The cathode surface at present is 5280 square feet, but is being increased to double this size. The deposition of the copper from the copper sulphate solution is very rapid and when completed is drawn off into the acid tanks and pumped back by means of a procelain acid pump to the lixivating tanks. The recovery of acid is very complete, exceeding 95%. The wash waters from the lixivating tanks, which contain small quantities of copper, are run into lead tanks below the electrolytic cells and precipitated from the solution by means of scrap iron. The sponge copper thus obtained is sold in this form, while the copperas or ferrous sulphate produced in the reaction is recovered.

The officers of the company are Darius L. Goff, President; Henry A. Stearns, Vice President; J. W. Phillips, Treasurer; and J. Edwards, Secretary. The head offices are 702 Banigan Building, R. I. Mr. Allan B. Chapman is manager of the mine at Dorchester, N.B.



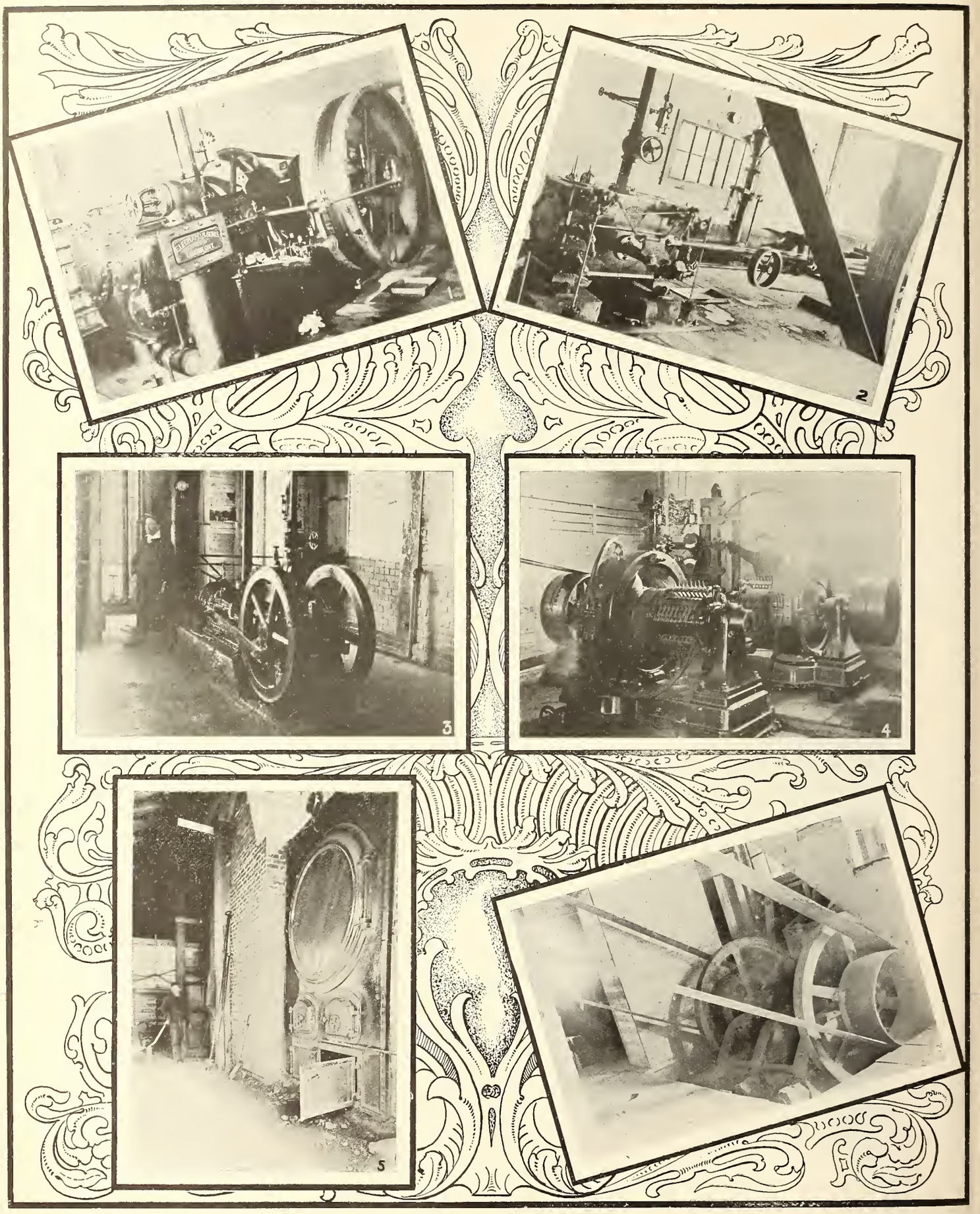
UNDERGROUND WORKS OF THE INTERCOLONIAL COPPER CO. AT DORCHESTER, N.B.

1. Inside Cut No. II. 2. Chamber in Level No. II., Shaft I. 3. Showing Face Tunnel about 130 ft. in and at depth of 176 ft. from surface; rich ore-body. 4. Third Level, Shaft No. I. 5. Face Tunnel in King lot, Shaft No. II. Good ore about 35 feet from surface. 6. First Level, No. I. Shaft. 7. Entrance of Tunnel.



MILLING PLANT OF THE INTERCOLONIAL COPPER CO. AT DORCHESTER, N.B.

1. Leaching Tanks. 2. Front of Roasters and Set of Furnaces (Dr. Carmichael, of Boston, in front) 3. Inside Electrolytic Tanks. 4. Top of Roasters. 5. Showing Tanks, Sheets and Spent Liquor Tank and Pump for returning acid to tanks for use again ; also tanks where cement copper is made from scrap. 6. Interior taken from rafters over Electrolytic Tanks. 7. Electrolytic Cells.



MINING AND MILLING PLANT OF THE INTERCOLONIAL COPPER CO. AT DORCHESTER, N.B.

1. Leonard Engine. 2. Laurie Engine. 3. Air Compressor at No. I Shaft. 4. Dynamo and Switchboard. 5. Boiler Room at Mill. 6. Ore Breaker and Rolls.

Notes on the Economic Minerals of Vancouver Island, B.C.

By W. F. Best, Victoria, B.C.

Vancouver Island, which is nearly as large as England, has a climate identical with that of the British Isles, and a geographical position as favourable for Australasian and Oriental trade, as England has for trade with Europe and America.

The island, which has been known as a mineral producing district for only a few years, is now attracting the attention of many mining people, both in Canada and the United States. In no portion of the British Dominions are there more promising indications of extensive and varied ore deposits than on Vancouver Island, and nowhere are there better facilities for profitable development of mines.

On account of the mild climate and absence of frost, it is possible to carry on mining operations throughout the entire year, while the numerous large streams, flowing from the mountains in the interior of the island, furnish an abundance of water-power.

Numerous excellent harbours and deep inlets indent the coast-line, and afford an opportunity for the exploration of the country near the sea coast.

The interior of the island is at present almost unknown, as the dense forests and tangled masses of vegetation form a barrier which even the intrepid prospector cannot penetrate.

Until trails and roads are opened by the Government, it will be utterly impossible to gain any adequate idea of the mineral resources, which, according to geological conditions, must exist in and near the mountain ranges of the centre of the island.

Wherever prospectors have been able to follow up the rivers, or in other ways to reach the vicinity of the interior mountains, they have been rewarded by important discoveries of valuable ore.

Among the ore deposits thus located those of the Mount Sicker district are probably the most important thus far discovered.

In the vicinity of the Mount Sicker claims that have been developed to the shipping stage a flourishing town is growing up, which at no distant day may rival the mainland city of Rossland.

Smelting works for the reduction of the ores of the Mount Sicker district are now under construction at Osborne Bay, a seaport some ten miles distant from the mines, and a second town, with hotels, stores, wharves, and dwellings, is in course of construction in the vicinity of the smelting works.

The ore of the Mount Sicker district is "chalcopyrite," containing copper, gold, and silver, the average value per ton being more than $20.00. At the 280 feet level in one of the Mount Sicker mines the ore is much richer than at the surface, and some remarkably high assays have been obtained.

Extensive ore reserves are "in sight," and at least 300 tons per day will be shipped to the smelter, as soon as the railway to Osborne Bay is completed.

At several points on the west coast of the island, along the inlet known as the Alberni canal, three or four very promising copper properties are in course of development, and many shipments of ore have already been made to the Tacoma smelter.

Other promising copper "prospects" have been found at Barclay Sound, and near Quatsimo Sound, at the north end of the island.

It is hardly necessary to make special reference to the coal mines of Vancouver Island, as they are comparatively well known. It may be mentioned, however, that for several years past the average output of these collieries has been about 1,500,000 tons per annum.

The coal measures of Vancouver Island occupy the eastern side of the island, and dip towards the Strait of Georgia, which separates the island from the mainland of British Columbia.

After copper and coal the most important economic mineral of the island is iron.

This metal exists in the form of "magnetite," containing from 60 to 68 per cent. metallic iron.

The largest known deposits are at Sechart, Sarita River, and Copper Island, although there is reason to believe that much more extensive deposits exist in the interior, as the sands of many of the streams consist chiefly of magnetic iron.

As far as tested the "magnetite" of Vancouver Island is remarkably free from phosphoric acid and sulphur, and is in every way suitable for the manufacture of "pig" iron and steel.

Vancouver Island "magnetite" is at present being exported to supply an experimental furnace situated in United States territory near Port Towsend.

It is most essential that at this stage of the industry an export duty should be placed on the ore, so that permanent plant and iron furnaces will be erected on Vancouver Island, instead of in United States territory.

To simply ship raw material from the island in order to build up a huge industry in the State of Washington is not at all desirable, from a Vancouver Island point of view.

The sooner this matter receives the attention of our legislators, the sooner will the revenue of the country increase from a most important industry.

Extensive deposits of "hæmatite," and also of clay ironstone, exist on the island, and as there are inexhaustible deposits of limestone, and abundant fuel close at hand, it would appear that Vancouver Island is an ideal location for iron works.

As for a market for iron and steel, there are all the countries bordering on the Pacific Ocean, countries that would consume the product of a dozen ordinary iron and steel works.

The principal discoveries of gold bearing quartz have thus far been made in the vicinity of San Juan river and its branches, on the west coast of the island, about 50 miles from the city of Victoria.

Recent assays of ore from a claim in that vicinity yielded 4 oz. (four ounces) gold per ton of ore.

While this cannot be taken as the average yield of the lode, yet the new district is certainly worthy of careful exploration.

In the same district a large and continuous vein of "stibnite" has lately been located, yielding 65 per cent. antimony, while a few miles distant a deposit of "galena" has been traced for several miles, on the surface.

An entirely new and very promising mineral district in the interior of the Island was reported by prospectors last summer, but on account of its inaccessible situation it will be some time before it can be profitably explored.

In that district large ledges of low grade "free milling" gold bearing quartz were found, but on account of their provisions running short the prospectors were obliged to leave the district, and hurry to the seacoast.

At Wreck Bay, and other places on the island coast, deposits of fine gold have been found associated with magnetic iron sand.

Some $12,000.00 was taken from one claim with rather crude appliances, which should encourage others to test similar black sand beaches.

It is probable that the beach gold has been derived either from lodes a few miles up streams, or from ancient river channels that had their terminations on the coast, in pre-historic times.

Thus far no systematic attempt has been made to ascertain the source of this beach gold.

The association of copper with some of the magnetite outcroppings on the island has led many persons to believe that the extensive magne-

tite deposits of Vancouver Island are simply the "capping" of large copper deposits at lower levels.

Should future investigation prove this theory to be correct, the possibilities of Vancouver Island as a copper producing country will certainly be remarkable.

Some very promising outcroppings of "cinnabar," containing an admixture of "native" quicksilver, have been found within 100 miles of the city of Victoria, but thus far very little has been done to test the extent or value of the ore-body.

Native arsenic, accompanied by gold, has also been found in well defined veins, but arsenic has apparently no charms for the people of Vancouver Island.

Lack of capital has retarded the development of many promising "prospects" on Vancouver Island, and there is nothing more needed on the island at the present time than a "Development Company," with sufficient capital to bring some of these prospects into the condition of shipping mines.

Americans, who investigate many reported discoveries in Canada, are beginning to turn their eyes towards the undeveloped mineral and other natural resources of Vancouver Island.

It is unfortunate that Eastern Canadian and British capital is not available for the development of Vancouver Island mining property, that in many instances would yield excellent returns on money expended.

More especially is it surprising that Great Britain, who sees her grip weakening upon the World's trade and manufactures, should not seek for reliable information respecting the mineral and other resources of that part of her Canadian domain bordering upon the Pacific

The fact is that at present most of the developed mines of British Columbia are in the possession of United States citizens, while England quietly slumbers and permits her most active and enterprising trade rival to gain a foothold in Canada which may mean much to the British Empire at a later date.

The expenditure of a fraction of the amount lavished upon the South African war, would have been sufficient to secure the development of deposits of economic minerals on Vancouver Island that would yield vast profits to the Motherland, and build up a prosperous British community in a position most favourable for commanding Oriental trade and maintaining British supremacy on the Pacific.

Eastern Ontario: A Region of Varied Mining Industries.

By Willet G. Miller, Kingston, Ont.

Numerous papers and reports have been written on the mines and mineral deposits of Eastern Ontario, or that part of the Province which we shall consider as lying east and south of the boundary line between the districts of Nipissing and Algoma. This region embraces all the older settled part of the Province, together with a considerable portion of the newer, or what is now called New Ontario. Although most of us are familiar with one or more special mining industries of this region it probably has not occurred to some of us that those industries are so varied in character. It is the purpose of the writer in this paper to draw attention to the great variety of the mineral deposits which are now being worked in the eastern part of the Province.

It will be seen from this paper, I think, that Eastern Ontario at the present time is producing as great a variety of mineral substances as almost any other part of the world of equal area. We have the variety and we hope and believe that in time the volume and value of our mineral products will compare favorably with those of most other countries of equal extent of territory.

While this paper deals with the mining industries of a part of the premier Province of the Dominion. it may not be out of place to point to the fact that Canada as a whole has a record as a mineral producing country to be proud of. As regards population we must be considered one of the smaller nations of the world. Compared with that of the mother country our population is small. Compared with that of the other English-speaking American nation, our population is almost insignificant, being considerably less than that of their greatest State.

Yet, in spite of this small showing of our population among those of the great nations of the world, we find that Canada stands third in the production of that metal which is and always has been the most sought after by mankind. The United States and Australasia alone lead us in the production of gold. Only seven or eight years ago we stood eleventh on the list of producers of this metal. Judging from this alone, we find that we are making good progress.

Then again Canada is unrivalled as a producer of that widely used mineral, asbestos.

This Dominion is one of the two countries which are practically the only producers of nickel.

In the production of another mineral, mica, which is of great importance in this age of electricity, Canada is one of the three chief producers.

There are also other inorganic or mineral materials, in which as regards value of output or cheapness of production, Canada compares favorably with any other country. But I must not dwell on these.

We hear a great deal about what our country is doing in the production of agricultural and dairy materials, and about our timber and fisheries in comparison with those of the rest of the world. We are glad to know that our cattle were adjudged to be the best on the two continents at the recent all-American exhibition held at Buffalo. Our horses are said to be among the best. Our timber is said to be unsurpassed as to quality and quantity, and our fisheries are acknowledged to be equal to those possessed by any country. We hear lttle, however, of our relative standing among the nations as a producer of mineral products. The reason for this is, I suppose, owing to the fact that mining men are proverbially modest and are not so much given to advertising themselves as some other classes of their fellow citizens!

I think, however, it will be seen from the statements I have made concerning the place our country occupies as regards its mineral products, that mining men are doing as much for this Canada of ours in comparison to their numbers as any other class of her citizens.

Eastern Ontario is not only a region in which a great variety of mining operations are being carried on, but the region to which the name applies is unique in respect to one or two industries in all America and almost in the world.

In the account of these industries I shall refer briefly to the character of the deposits now being worked, as well as to the products obtained. In conclusion I shall mention the uses made of some of these products.

NICKEL AND COPPER.

Beginning at the western edge, the boundary between the districts of Nipissing and Algoma, of the region under review, we have the Sudbury nickel mines. These deposits, which have been worked during the last twelve or fourteen years, have been frequently described. The ore consists essentially of phyrrhotite and chalcopyrite, in somewhat irregularly formed deposits associated with basic rocks which are typically hypersthene gabbro. The ore bodies lie at or near the contact of this rock with granite. It has generally been claimed that the ore bodies are of igneous origin., *i.e.*, that the phyrrhotite and chalcopyrite have separated from a molten mass of rock as it began to cool, and were deposited at or near the contact of the granite. This theory of origin is based largely on hypothesis. It is based on the supposition that the granite in contact with the gabbro in which the ore bodies occur is older in age than the gabbro. This does not seem to have been proved.

The writer's observations lead him to believe that the granite in contact with the gabbro is never the older of the two rocks. In many cases the granite is clearly younger than the gabbro. That the ore bodies have been the scene of some secondary action is evident from the fact that veins of pyrite and galena are occasionally found running through the massive pyrrhotite and chalcopyrite. If all the granite in association with the gabbro is the younger of the two rocks, or even of the same age as the gabbro, the ore bodies must be considered to be essentially of secondary and not wholly of igneous or primary origin. In all the other districts in our Archæan with which I am acquainted the granites are usually younger than the older of the diorites and gabbros.

In addition to the chalcopyrite and pyrrhotite, which are the more important minerals in the nickel deposits, other nickel-bearing minerals, such as pentlandite, gersdorfitte, and niccolite are at times met with. Some amounts, frequently merely traces, of gold and platinum, are found in the ore. On the waste heaps copper pyrites is seen to be more plentiful in the rock than phyrrhotite, the latter mineral making up the greater part of the more massive deposits. The analyses of a number of samples, from one property in each of five different townships in the nickel belt, were found to average nickel 2.48 per cent, and copper 0.86 per cent. Many of the deposits, however, run considerably higher than this in metallic contents.

Bessemer matte produced from some of these Sudbury ores was found to have the following composition :—

*Copper	per cent 43.36
Nickel	per cent 39.96
Iron	per cent 0.30
Sulphur	per cent 13.76
Silver	per ton, 7 ounces
Gold	per ton, 0.1 to 0.2 ounces
Platinum	per ton, 0.5 ounce

The deposits are found at different points over a strip or belt of country which is somewhat lenticular in form, its greatest diameter, from S.W. to N.E., being 50 to 60 miles in length, and its breadth in its widest part being something like 25 miles.

There is considerable demand in the Province for iron pyrites as a source of sulphur, but up to the present no method has been adopted for utilizing the sulphur contained in these copper-nickel ores. It may be of interest to see what the value of the sulphur roasted off these ores would be if it could be saved. Let us say that 1200 tons of ore are roasted on the average in the district daily. Pure pyrrhotite contains about 38 per cent in sulphur, but let us assume that the ore averages only 25 per cent. The sulphnr contained in the 1200 tons of ore would amount to 300 tons.

Since it takes about eight tons of ore to produce one ton of matte, the 1200 tons of ore will represent 150 of matte. Following the analysis just quoted, let us say that the matte contains 14 per cent sulphur, or the 150 tons of matte contain 21 tons of sulphur. Deduct this 21 tons from the 300 tons, and we find that 279 tons of sulphur, approximately, are driven off from the ore on the roast heaps and in the smelters daily.

Iron pyrites, containing 50 per cent. sulphur, sells at about $5.00 per ton. Or one ton of sulphur, contained in two tons of iron pyrites, is worth $10.00. On this basis the 279 tons of sulphur in the pyrrhotite wonld be worth $2790 if it could be saved, or the 300 tons, the amount of sulphur contained in the 1,200 tons of ore, would be worth $3000. While the percentages made use of in this calculation are only approximately correct, they will serve to show roughly the amount of sulphur which is lost.

Of course the same loss of sulphur takes place at other metallurgical works in different parts of the world. It would seem, however, that there is a good field for experiment here with a view to saving the sulphur. Moreover, there is another object in not driving the sulphur into the air in such cases. It is a nuisance to the inhabitants, as it pollutes the air they breathe and destroys the vegetation over a considerable area, giving the country in the course of time so desolate an appearance that its effects are well compared to those produced by a recent lava flow, not a blade of vegetation to be seen.

In hand specimens the Sudbury ore is difficult to distinguish from those of some of the Rossland, British Columbia, ores. In one case the ore is valuable as a source of nickel and copper, while in the other gold and copper are the metals sought for. If a Sudbury prospector had been the first to discover the Rossland deposits, he would likely have been keenly disappointed if on analysis no nickel was found in them.

Other deposits of pyrrhotite occur in the more eastern part of the Province, but they are associated with rocks of a different character from those of Sudbury, and contain no commercial amounts of nickel.

IRON.

Proceeding eastward from Sudbury iron ores are met with in the district bounding Lake Temagami on the east and west. These ores have had very little work done on them up to the present, but judging both from the wide extent of country over which the iron-bearing rocks are found, and also from their character, the district should contain deposits of value. The iron-bearing formation here, I may say, is similar to that of the great mining districts of Michigan and Minnesota, the ore being associated with jasper and related material. During the coming summer, the Ontario government is to begin building a railway through the Temagami district. This will greatly facilitate the prospecting of the iron ranges.

In the more southern and eastern parts of the region under review iron ore deposits are found over a large territory. These ores occur in deposits of different character from those just referred to, and have been worked at different times. In a paper published in last year's proceedings of this Institute I gave an account of the iron ore fields of the Province, and it is not necessary for me to review the matter further here.*

GOLD.

Eastern Ontario produces one other metal, gold, in addition to the three to which reference has been made.

The Wahnapitae district, which lies to the east of Sudbury, has attracted much attention as a gold field. A few years ago a number of deposits were opened up and some very rich ore was produced. Systematic work has been done on one property during the last year with very satisfactory results.

The placers along the Vermilion river, in the region to the northward of Lake Wahnapitae, judging from official reports which have been made on them to the government, seem to be worthy of more attention than has been given to them.† The region in which these placers are situated is difficult of access, and mining operations have thus been impeded, as they appear to be suitable for working only by large plants, and are not "poor man's diggings." During last summer work was done, I believe, by one company.

The only part of Eastern Ontario, however, in which gold is being produced is what is generally called the Hastings district. A strip of country in this district stretches from the eastern edge of Peterborough county in a direction north of east across the northern part of the counties of Hastings, Lennox and Addington, and Frontenac. Historically the district is interesting on account of the fact that through it attention was first directed to the Province as a gold territory. Morals of a mining nature may also be drawn from its history in connection

*Min. Ind., Vol. III, p. 460, and Bur. Min. Ont., Vol. IX, p. 218.

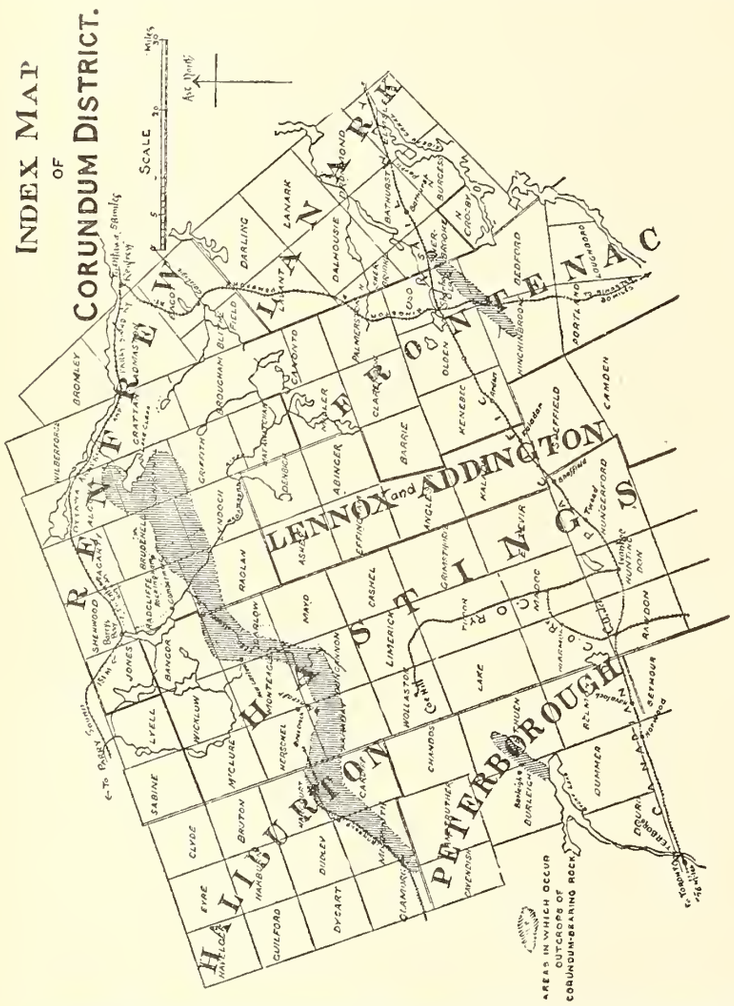
*Iron Ore Fields of Ontario, also Iron Ores of Nipissing, Vol. X, Bur. Mines Ont.

†Reports Ont. Bur. Mines, Vol. VII, pp. 256 to 259, and Vol. X pp. 151 to 159.

with the various schemes and attempts which have been made to produce the precious metal. It probably would have been much better for the Province if the precious metal had escaped observation for 20 or 25 years after its discovery was made, when mining methods were better understood and we had a population which had had experience in other fields.

In addition to glacial and recent deposits, there are four important types of rocks in connection with this gold belt. These are Silurian limestone, which overlies the Archæan uncomformably, being deposited on the eroded surface of the latter, together with granite, diorite, and crystalline limestone. The latter rock frequently possesses a highly schistose structure, and is spoken of as calc schist. Under the name diorite are grouped a variety of massive and schistose representatives.

The granite is the youngest of the crystalline or Archæan series, and is found cutting through both the diorite and the crystalline limestone. Of the latter two rocks the diorite in the eastern part of the



The lower part of this Map shows the location of the Eastern Ontario gold belt which runs north of east from the Township of Belmont, in Peterborough County, across the Counties of Hastings, Lennox and Addington, and Frontenac.

Map by W. G. Miller, 1898.

belt is the younger, as dikes of it penetrate the limestone. Along the western portion of the belt the relations are not quite so clear, although it would appear that the same relation holds. It is possible, however, that some members of the diorite series are of different age from the others.

The gold deposits are in most cases associated with the diorite, and frequently occur near the contact of this rock with the granite. When occurring at or near the contact the ore is essentially composed of mispickel and quartz. A few deposits in the eastern part of the belt are found at or near the contact of diorite with crystalline limestone, and are also high in mispickel. The Belmont mine, which is situated well within a diorite area, contains pyrite in place of mispickel.

The ore bodies situated near the contact of diorite and granite are evidently of later age than the younger of these rocks, as they cut across both of them. The cavities in which the deposits are found appear to have originated first as narrow cracks through the shrinkage of the granite mass on cooling, and to have been afterwards enlarged through the agency of water.

The Belmont mine, in the township of the same name, which has been in operation some years, has a recently erected 30-stamp mill and a cyanide plant for the treatment of concentrates. The Deloro mine, in Marmora township, is running a 20-stamp mill, and has a bromo-cyanide plant for the treatment of its concentrates. This plant and the method of treating the ores, were described in two papers in last year's transactions of this Institute, and need not be further referred to here.* The Atlas Gold and Arsenic Company have a 10-stamp mill and are working properties adjacent to the Deloro and others more distant.

Details concerning the development work done at these mines, and the character of their plants, will be found in recent publications.†

ARSENIC.

The Deloro mine, in the township of Marmora, Hastings County, is unique in being the only mine in Canada which is a producer of arsenic. The arsenic occurs in the mispickel, and is associated with gold, as already stated. About 80 tons of white arsenic or arsenious acid are produced monthly by this mine, and by far the greater part of the product is shipped to the United States.

The arsenic plant presents an interesting sight to the visitor. In looking at the piles of the innocent appearing white powder one can hardly realise that it is anything but wheat flour.

Many of the workmen in the plant have their faces painted with ferric oxide, which acts as an antidote to the poisonous fumes. When I first visited the mill, I wondered why the manager showed such a preference for birth-marked men or where he succeeded in getting so many of them. It did not strike me at first that the coloring of their faces was artificial.

There are a number of other important mispickel properties in the district, among which are those controlled by Mr. W. A. Hungerford and associates and others in the vicinity of Deloro, and those belonging to Mr. Joseph James. The latter are situated near the village of Actinolite.

The arsenic industry is only in its infancy in this district. Under favourable conditions it should be developed to such an extent that the American market will be controlled by this Province, and an important foreign trade in other parts of the world should be secured. The district is easy of access to the chief markets for arsenic in the United States, and is well situated as regards European trade.

Some of the numerous uses made of the compounds of arsenic will be referred to towards the end of this paper.

PYRITE.

Iron pyrites has been mined quite extensively during the past year, in the vicinity of Bannockburn station, on the Central Ontario Railway, in Madoc township. The work is carried on by an open cut. The associated rock is of a talcose nature, but the ore body, which has a considerable width, is pretty free from intermixed rock matter.

The deposit was first worked as a bog ore, the pyrites being decomposed at the surface. A short distance down, however, the bog ore was found to pass into pyrite.

* "The Treatment of Auriferous Mispickel Ores," by Messrs. P. Kirkegaard and Sidney B. Wright. Vol. IV Canadian Mining Institute.

† Reports Ont. Bur. Mines.

No doubt there are many other workable deposits of this mineral in the Province. As, however, the mineral tends to weather more rapidly than the surrounding rocks, the deposits often occur in low ground and thus escape observation.

CORUNDUM.

Eastern Ontario is the largest producer of pure corundum in the world, and possesses what there is every reason to believe are the largest known deposits of this mineral. Before the opening of these mines it was impossible to buy corundum in any quantity on the market, although strenuous attempts had been made to obtain a supply in different countries. At the present time, I am told, Ontario corundum is alone used by Canadian manufacturers of abrasive goods, and a large market is being found for it in the United States. It is also gradually being introduced into Europe.

The only plant so far erected in the Province for the concentration of conundrum is located in the township of Raglan, Renfrew County, the product being shipped *via* Barry's Bay, a station on the Canada Atlantic railway.

Corundum is found in the district as a constituent of igneous rocks which embrace the ordinary varieties of syenite, together with syenite pegmatite, nepheline syenite, and anorthosite. The localities in which the mineral occurs, together with details concerning its modes of occurrence, will be found in different reports published by the Provincial and Dominion Governments.* An account of the process employed in milling and concentrating the mineral is given in a paper by another writer presented at this meeting of the Institute.

MICA.

The south-eastern part of Ontario, together with some of the adjacent territory of Quebec, is well known as one of the world's chief producers of mica. It may be well to contradict a statement here, which I recently saw in a text-book on economic geology, to the effect that all the mica of commerce is the variety known as muscovite. This mica is the product of the mines of India and North Carolina and some other countries, but the variety produced in Ontario and Quebec is phlogopite. On account of its color our mica is known in the trade as amber mica. It is claimed to be softer and better adapted to electrical purposes than muscovite. The clear white color of much of the latter, however, makes it a more suitable material for decorative purposes, such as for use in stove fronts, than the amber mica. The demand for the mineral in electrical works is, however, by far the more important.

Amber mica is found in irregular shaped deposits associated with calcite, pyroxene, apatite, and other minerals, some of which occur in very large crystals. These deposits are of secondary or aqueous origin, while white mica and other varieties of muscovite are obtained from dikes of pegmatite or coarse grained granite, which are of aqueo-igneous origin. Years ago, when phosphate or apatite was much sought after in the Province, the mica found associated with it was considered of little value, and much of it was thrown in the waste rock heaps. This was, of course, before the great electrical development which has taken place during the last few years. Recently many of these dumps have been worked over, and the mica has been carefully sorted out. During recent years, since the fall in the price of phosphate, the most of what little of this material has been produced is a by-product of the mica mines.

At the present time two very important mica mines are in operation in Frontenac County. One of these, operated by the Messrs. Kent and associates, of Kingston, is known as the Kent mine. The other is generally known as the Lacey mine, since the deposit now being worked is not many feet distant from this mine, which was operated a number of years, and was one of the greatest producers ever worked in Canada. The amount of mica in sight in the mine at the present time is said to be greater than any ever before uncovered in the country. Crystals of mica of very large size are obtained. In the old workings crystals six feet in diameter were met with. This mine is situated a few miles from Sydenham village.

The product from the Kent mine is shipped to Kingston, where it is prepared for the market. This company is reported to have lately begun to utilize the small pieces or scrap mica produced in their works. The scrap is split up into thin layers, and these are cemented together into large sheets which are said to answer well for use in connection with some parts of electrical machines where heat and friction are not great.

Another important use for scrap mica is in the manufacture of coverings for boilers. This invention was patented by some residents of Canada a few years ago. That it is of much commercial importance is seen from the fact that the company manufacturing the covering were given the highest award obtainable, a gold medal, at the recent Pan-American exhibition. India is said to produce one-half of the world's supply, and Canada and the United States about one-quarter each. The United States consumes more than one half, including all its own, the most of the Canadian, and a large fraction of that of India,



Concentration Plant of the Canada Corundum Co., Raglan Township, Ont.

the amount of Canadian and Indian mica imported each being about equal to the home product. The remaining Indian mica goes almost all to England, and is there partially re-shipped to Germany and France, the only other users of consequence.

TALC.

Eastern Ontario has, I believe, the only talc deposit in Canada which has been a producer. Within the last year or two this mineral has been mined in tne vicinity of the village of Madoc, and a considerable quantity of it has been shipped to the United States. The quality of the material has been reported to be good and the deposit appears to be of large size, little waste material being produced in mining. The deposit is associated with crystalline limestone.

GRAPHITE.

As long ago as the Centennial Exhibition of 1876 the Province of Quebec made a good display of graphite and articles produced from this mineral. But for some reason, probably owing chiefly to trade prejudices, Canada was not able for many years afterwards to develop a graphite industry of any importance. Within the last three or four years, however, a graphite deposit of large size has been developed in Renfrew county, a few miles from Calabogie station. Up to the present time the mineral has been marketed only in the crude state.

* Reports Geol. Survey, and Vols. VII and VIII Bur. Mines, Ont.

That the mineral is of high quality is evident from the fact that as much as five dollars per ton is said to have been paid for drawing it from the mine to the railway station in summer. Nothing but a substance of the first grade would stand such an initial expense in competition with that of older mines in other countries. A large plant for refining the mineral is now being erected at the mine, and the property will be worked under much more favorable conditions.

FELDSPAR.

This is the youngest and hence may be called the baby mining industry of Eastern Ontario. Some 4,000 tons of feldspar were mined last winter, a short time after the deposit was opened up. This quantity was all sold in the United States during the season of lake navigation. At the present time the owners are engaged in mining some 7,000 tons to fill contracts that have been made, and expect that within the next few months they will have sold double this amount.

Attempts have been made over and over again to develop a feldspar industry in Ontario, but without success till last year. Success would not have been achieved even now had the problem not been in the hands of thoroughly trained business men. The item of freight is a very important one, as the margin of profit is not large in any case.

Considerable difficulty was met with in trying to market the material, owing to the fact that many of the large users of feldspar were found to be working deposits of their own and tried to discourage the mining of the mineral in this country.

The deposit which is now being worked in Ontario is situated near Bedford station, on the Kingston and Pembroke railway, and is of very large size. The feldspar occurs in large masses remarkably free from quartz and other minerals. That it is of a superior quality is evident from the fact that orders have been received from some of the largest pottery companies in the United States, now that they have found that other companies are using the Ontario material and that it cannot be kept out of the market.

The same difficulties in gaining a market in Great Britain have been met with as were encountered in the United States, but it is believed that in the near future an important trade will be established with the United Kingdom.

The following are analyses of specimens from different parts of the deposit:—

	(1)	(2)
SiO_2	65.40	66.23
Al_2O_3	18.80	18.77
Fe_2O_3	Trace	Trace
CaO	....	0.31
MgO	....	....
K_2O	13.9	12.09
Na_2O	1.95	3.11
Loss	0.60	....
	100.65	100.51

ACTINOLITE.

While feldspar may be called the newest of the mining industries of Eastern Ontario, the mining and grinding of actinolite can be put down as the oldest, since this industry has been going on continuously since 1883. Of course in making this statement I leave out of consideration the production of lime and other materials which are produced in small amounts in numerous places for local consumption. Moreover, I refer only to those substances which are derived from deposits in crystalline rocks.

At what is now the village of Actinolite, formerly Bridgewater, in Hastings County, actinolite, together with other minerals, is mined and ground for use as a roofing material. During the last twenty years large quantities of it have been shipped to the United States, and the composition made of it has been used on some of the largest buildings in Chicago and other leading cities.

CEMENT.

Another industry of a mineral character and of great and growing importance in building operations and engineering works is that of Portland cement. Ten years ago this industry was in its infancy, and there were strong prejudices against the use of material of domestic production. During the last two or three years a number of large factories have been erected. The cement produced in the Province is now known to be of as good quality as is to be obtained anywhere.

As, however, the materials used in the production of cement are not derived directly from our crystalline rocks, I shall not refer further to it, it being necessary, in order to keep this paper within reasonable limits, to restrict it to substances produced in areas underlain by our older or Archæan system. For the same reason I shall pass over our clay industry, which is destined to become a very important one, and has up to the present been comparatively neglected. Most of our building stones also come from our newer rocks.

Then there are the important mineral industries, petroleum, natural gas, salt, and others, to which time will not permit of more than a mere reference.

I think, however, that I have shown that Eastern Ontario has as great a variety of mining industries as probably any other area of the earth's surface of equal extent, although I have omitted reference to some of the least important industries.

I have not referred to the uses of the minerals which I have mentioned, wsth the exception of one or two. In concluding I may be permitted to notice them briefly.

The metal nickel, the production of which has probably made the Province more widely known than that of any other substance, has many uses. It may be called the metal of defence, since it is being adopted so rapidly as a constituent of steel for use in armour plate by the navies of the world. As a constituent of steel required for ordinary purposes it has a wide field of usefulness. Then there are its uses in plating and in coinage. It seems to me that since Canada is such an important producer of the metal we should have a distinctively nickel coin.

It is necessary for me to refer but briefly to the uses of copper, whch our Province produces along with nickel and from other deposits. In pre-historic times, before the advent of the iron age, copper was the metal chiefly used in the production of tools and articles of every-day use. In later ages it occupied a much less important place in the industries than iron. In recent years, however, as in the early ages of human history, copper has become an indispensable metal. In our present state of development we could not do without iron, and the same may almost be said concerning copper. We are now in what is sometimes called the age of electricity, and if our supplies of copper were suddenly cut off we can hardly conceive of the state we would be left in, at least until some substitute were found for the metal.

Of the other metal to which I have referred in this paper, it may be said that it has apparently been the metal most eagerly sought after by the race of man throughout all ages, alike by barbarians and those in higher states of civilization. Much has been written of its uses and abuses. However, I think it can be said that, with all the ill uses to which it has been put, it has proved a greater factor in bringing about the settlement of waste places and in promoting civilization than any other substance, organic or inorganic. Gold-bearing deposits have been the lodestone which attracted population to the wildernesses of Western America, Australia, and Africa during the century just closed. In spite of all endeavors of statesmen and the often quoted missionaries these vast regions would even now have had very sparse populations had it not been for the great promoters of civilization, the men with the pick and shovel in search of gold.

The manufacture of sulphuric acid, which is used in the produc-

tion of many substances, makes a steady demand for iron pyrites, and I have shown that Eastern Ontario is now a producer of this mineral.

The uses of white arsenic or arsenious oxide, of which Hastings County is becoming so important a producer, are numerous. It is the base of different paints, and is also a constituent of certain varieties of glass. In agriculture it is used extensively as an insectide. In medicine it also finds important application. There is reason to believe that in the future the demand for the material will greatly increase, especially in connection with agriculture.

Just a few words as to the uses of the non-metallic products of Eastern Ontario to which I have referred.

I have stated that we are the greatest producers of pure corundum. This mineral is of great importance in the arts, as it is used in grinding into shape and polishing various parts of machinery of all kinds. At times it is used in the loose or granular form, but most frequently the grains are cemented together in the form of wheels. Some of these wheels can be used only in the dry state, while others are used with water. In the former the binding material is usually soluble glass, while in the latter it is some material which has been fused by subjecting it to a high temperature.

The consumption of mica has greatly increased during late years. This is owing to the fact that the mineral is used very extensively at the present time as an insulator in electrical machines. In addition to this use there is also more or less demand for it in the stove and lamp trade. Mica flour, or as it is commonly called, ground mica, has also recently become an important article of commerce. In this form it is used for coating wall papers, to which it gives a brilliant and lasting lustre. Only scrap or refuse mica is used for grinding. This use of scrap, together with its use in the production of large sheets by cementing flakes together, has made a demand for this material, which was formerly a waste product.

Talc, in the form of flour, is an important substance in the paper industry. It is used as a filler or to give body to paper.

Graphite is used as a refractory material in furnace linings and in crucibles. It is, moreover, a constituent of stove polish, and in addition to other uses, there is a growing trade in paints whose chief constituent is graphite.

Of the many kinds of feldspar the chief one used in the arts is the potash variety or orthoclase. It is usually a light pink in color, and forms the chief constituent of the glaze in pottery and in the body of different kinds of so called earthenware.

Actinolite, as already stated, finds a considerable application as a roofing material.

Of the uses of building materials, cement, clay, and stone, it is not necessary to refer.

The uses of other mineral substances, such as salt, petroleum, and natural gas, of which the southern part of the Province is an important producer, do not need to be mentioned.

Before concluding this paper it may be well, in order to show the standing Ontario has among other American countries as a producer of minerals, to refer to the awards she received on her mineral exhibit at the recent all American exhibition held at Buffalo. These awards were practically all given in connection with exhibits composed of minerals and mineral products from the eastern part of the Province, the region to which this paper relates.

The following is a press account which appeared shortly after the awards were made:

"The official list of awards obtained by the Ontario mineral exhibit, made by the Bureau of Mines at the Pan-American Exposition, shows that the exhibit was not surpassed by any in the Mines Building, if, indeed, there were any which equalled it. Three gold medals, the highest honor conferred at the Exposition, were awarded the exhibit, while, with the exception of Mexico, which also received three, and Chili, which got two, no other State, foreign country, or individual obtained more than one.

"One ot the gold medals was for the excellence of the exhibit as a whole, viewed as a collection of "the economic ores and minerals, maps, and photographs illustrative of the mineral resources of Ontario," and one was for the "installation" of the exhibit, a term which includes the general plan and arrangement of the exhibit, the effectiveness of the display, and the decorations. The Ontario exhibit was the only one in the Mines Building to receive this award, notwithstanding that equally elaborate and much more expensive schemes of installation were adopted by several other of the exhibiting States and countries. Maryland was the only State of the Union to be adjudged a gold medal for



Concentration and Refining Plant in course of erection at the Black Donald Graphite Mine, near Calabogie.

a similar collection of economic minerals, the remaining exhibitors who shared the honor being the Governments of Bolivia, Brazil, Chili, and Mexico. The third gold medal granted in the Ontario section was to the Mica Boiler Covering Company, of Toronto and Montreal, on their mica covering to prevent the radiation of heat from boilers and steam pipes. The judges made the awards after a scrutiny of the results of the tests of mica for this purpose in comparison with magnesia and asbestos.

"The next highest form of award was the silver medal, and of these no less than seven fell to the lot of Ontario, one to the Bureau of Mines itself, and the others to individual companies, whose displays formed part of the collection. The very interesting and complete assemblage of gold and arsenic ores and products made by the Canadian Gold Fields, Limited, of Deloro, Hastings County, was unique of its kind in the building, and was very properly granted a silver medal. The magnificent collection of copper-nickel ores and products shown by the Bureau of Mines, to which the Canadian Copper Company and the Orford Copper Company were the chief contributors—and which was probably the most imposing exhibit of the kind ever made, some of the specimens of ore weighing as much as five tons—also won the silver medal. The Orford Copper Company's exhibits of refined nickel and copper from Sudbury matte, as well as

nickel goods and nickel-steel, were very instructive, and the whole display was well calculated to draw attention to the nickel resources of Ontario. Other silver medals were awarded to the Canadian Corundum Company for a comprehensive display of corundum ores and products, which well set out in its wealth of material the abundance of the newly opened stores of this useful substance possessed by the Province; to the Hamilton Steel and Iron Company for iron and steel shapes, angles, bars, etc., with iron ores; to the Lake Superior Power Company, Sault St. Marie, for pig iron, ores, charts, and an electrically illuminated and very effective map of Northern Ontario; to the Milton Pressed Brick and Terra Cotta Company, Milton, for an exhibit of pressed brick and terra cotta, which took the form of an arch specially designed and manufactured, forming part of the scheme of installation; and to the Ontario Graphite Company, of Ottawa, for the handsome exhibit of graphite, comprising blocks of unusually large size, and forming the shaft on which rested the emblematic statue of Canada, made by Mr. J. L. Banks, of Toronto, the centre round which the whole Ontario collection was grouped.

"Of bronze medals, the next highest form of award, six fell to Ontario's lot. One of these went to the Nickel-Copper Company, of Hamilton, for an exhibit of ores and products illustrative of the various operations in the reduction of nickel and copper by the Frasch process, an interesting and significant display; one to the Bureau of Mines, for an exhibit of raw mica, including muscovite, phlogopite,



Faulted Corundum Crystal in Felspar.—Craig Mine, Raglan Township, Ont.

and biotite; one to the Imperial Oil Company, of Sarnia, for a display of Ontario petroleum and its products; a fourth to the Peat Development Syndicate, Toronto, for an exhibit of peat and its products, drawing attention to an industry which promises to become one of great importance to Ontario in the near future; a fifth to the Stewart Granite works, of Hamilton, for carved and polished syenite, a handsome block from a quarry near Gananoque; and a sixth to the Caledonia Springs Natural Mineral Water Company, for mineral waters.

"On the honorable mention list were five of the exhibitors in the Ontario section. Dr. R. A. Pyne, M.P.P., Toronto, received this award for graphite and products, the output of a mine near Oliver's Ferry, on the Rideau Canal; James Richardson and Son, Kingston, for felspar, shown in immense blocks of fine quality; the Crown Corundum Company, of Toronto, for corundum ores, the Queenston Quarry Company, St David's, for cut limestone blocks for building purposes; and the Canada Iron Furnace Company, of Midland, for iron ores and pig iron.

"In addition to full recognition of the merits of the Ontario collection as a whole, the awards received covered almost every mineral product of importance in the display. Gold, arsenic, nickel (two awards), copper, iron, including ores and manufactures (three awards), corundum (two awards), pressed brick and terra cotta, graphite (two awards), mica (two awards), petroleum, peat, building stones (two awards), felspar, and mineral water were singled out for awards of varying degree. In all, three gold medals, seven silver medals, six bronze medals, and five honorable mentions were adjudged the exhibit, a total of twenty-one awards. Owing to the method of making and announcing the awards, it is hardly possible to institute comparisons with other exhibits, but an inspection of the list leads to the conclusion that Ontario has done very well indeed. Certainly no State of the Union fared better and probably none as well. There was no Canadian representative on the Board of Commissioners who made the awards."

Hoisting and Haulage in Mining Operations —A Description of the Plant on the Le Roi Mine, Rossland B.C.

By Bernard MacDonald, M.E., Rossland, B.C.

Progress in everything is marked by continual change and continual growth. Whatever survives the present must change or grow to meet the demands of the future. What was the nearest approach to perfection in the economic arts and sciences a few yeaas ago is antiquated today. The truth of these aphorisms is nowhere more clearly demonstrated than the progress made in the art of mining, especially in more recent years

In the early history of mining on this continent, during the 16th and 17th centuries, when the Spaniards were skimming the cream of the phenomenal deposits of silver ores found in Mexico and South America, the Indian peons, climbing notched poles, carried the ore out of the mines on their backs. From the mouth of the mines, donkey pack trains carried it to the reduction works, more or less distant. If water was encountered in the workings, it was filled into leather bags and dragged to the surface by mules or horses. The Indians and the donkeys, moving slowly with loads of from 50 to 200 pounds, and the mules and horses hoisting the sacked water, constituted the hoisting and haulage system used in the mining operations of those days.

While the ores were rich, near the surface, and the mines were comparatively dry, these methods served very well, that is, the mines operated in this way left a margin of profit for the Spanish owner and a living for his peons. But when the ores became poorer, or the mines were exhausted to even inconsiderable depths, or water was encountered, the limit of profitable operations was reached and the mines were abandoned. Thus, human and animal labor, unaided by mechanical appliances, reached their limitation, to use the Western phrase, "very early in the game."

From this time, history shows that the limitations of successful mining have widened continually as progress has been made in the perfection and adaptability of machinery suitable for the work done by manual or animal labor. It may now be asserted that the economies effected by the use of machinery in mining operations are more prominent in the work of hoisting and haulage than in that of any other department. And although it is true that special mechanical appliances have invaded all departments of mining, it must be admitted that

hoisting and haulage, on account of this prominence, are entitled to distinction as the mechanical department.

Of course, the introduction of machinery in mining, as in other branches of industry, presumes the certainty of abundance of work, suitability for the work, and proper installation. Without these prerequisites, no installation would be warranted, or the results profitable. Nor does the fact that occasionally it is good business to install auxiliary units of machinery in a large plant to stand guard, as it were, in like manner as insurance is placed, alter this as a general rule.

The economic results obtained from the modern hoisting and haulage plant erected on the Le Roi under the design and supervision of the writer, goes to corroborate what has been said, and as this plant has many novel features, both of design and application, it is hoped that a description of it and the economies affected by its operation will prove interesting. In this description which follows, many incidental circumstances, apparently extraneous to the subject matter proper of this paper, will have to be narrated, in order to give a comprehensive grasp of the economic exigencies which created the necessity for this plant. It is also hoped that such extraneous matter will not be uninteresting, inasmuch as it constitutes a chapter in the history of one of the most prominent mines in this province, and deals with many of the peculiar conditions which are, to a more or less degree, characteristic of all mining enterprises.

Historical.—The Le Roi was located in the summer of 1890, and in November of the same year it was bonded to a syndicate of Spokane business men. This syndicate completed the purchase of the mine, and on the 23rd June, 1891, conveyed it to the Le Roi Mining Company, which they organized for the purpose of operating the mine. Under the auspices of this company the mine was developed into a paying property, and the company realized from its operations $975,000.00 in dividends before selling it in 1898.

The ore which yielded these dividends was extracted from workings comparatively near the surface, where, owing to the concentrating action of meteoric agencies, the values, originally existing in the entire vein, were concentrated into a streak of varying width. The ore mined was sold to custom smelters, which made a direct charge of $11.00 per ton for freight and treatment, besides making certain deductions from the metal values, which amounted to approximately $5.00 per ton. Thus, the aggregate of the direct and indirect smelting charges was $16.00 per ton.

But as depth was attained on the vein, it was found that the values were becoming more uniformly disseminated throughout the great width of vein matter, instead of being, as near the surface, concentrated into a comparatively narrow streak.

Thus, as the work of mining progressed in depth, the ore became too low-grade to stand the cost of freight and treatment formerly paid to the smelters and leave a satisfactory margin of profit.

This change in the character of the ore induced the company to build its own smelter, so that the profit of smelting the ore might be added to that of mining it.

A favorable site was selected at Northport, in the State of Washington, and a smelting plant of the capacity of 250 tons per day was built there in the fall of 1897.

In this enterprise the company associated with it to the extent of one-quarter interest, Mr. James Breen, a man of extensive experience in copper smelting. Mr. Breen's ownership of this interest made it necessary to operate the mine and smelter as separate concerns.

The smelter was operated under terms of an agreement made between Breen and the Le Roi Mining Company, which provided that all the ores produced by the Le Roi mine for a period of five years should be sold to the smelter on the following terms:—The gross values of the metals contained in the ore was to be paid for at New York market quotations, less $8.75 per ton as direct charge for freight and treatment, and certain specified deductions from the gross metal values in the ore, which amounted to $5.00 per ton additional. Thus the total charges, direct and indirect, for smelting the ore at the Northport smelter, amounted to $13.75 per ton, a reduction of $2.25 per ton under the price charged by outside smelters. This contract was, nevertheless, very profitable for the smelter, the profits earned being distributed, three-quarters to the company and one-quarter to Breen.

About this time the president of the Le Roi Mining Company (Col. I. N. Peyton) went to London for the purpose of selling the mining and smelting property of the company. The negotiations which Col. Peyton began, finally resulted in the purchase of all the assets of the company by the British America Corporation, Ltd. This corporation conveyed the property to the "Le Roi Mining Company, Limited," a new company, organized in London to take over and operate the mining and smelting property of the old Le Roi Company.

The mining and smelting operations of the new company were then conducted under the management of the new (London) company, Mr W. A. Carlyle being local manager until December, 1899, when that gentleman severed his connection with the company to accept the management of the Rio Tinto Copper Mines, in Spain.

At this time—on the 10th December, 1899—the writer was appointed general manager to fill the position made vacant by Carlyle's resignation. On accepting this position I was informed by the directors that no profit had been made by the company's operations and was instructed to examine the company's property and report as to what would be the probable result of future operation

I immediately began the examination of the mine, the compilation of records of previous production and working costs, and a study of the commercial problems involved in the mining and smelting operations of the company.

The mine records showed that for the eight months ended June 30th, 1899 (the first eight months after the mine was taken over from the old company) there were 45,167 tons of ore shipped, having an average gross value of $17.33 per ton; and that for the subsequent six months ended December 31st, 1899, there were 51,448 tons of ore shipped, having an average gross value of $13.66 per ton, making a total of 96,615 tons of ore shipped during this period, having a total gross value of $1,485,423.19. This made the average daily shipment about 250 tons, which, upon investigation, I found was the maximum which could possibly be obtained from the mine with the equipment and facilities it then possessed. To maintain even this, the miners were obliged to climb into and out of the mine to depths ranging to 900 feet so as not to interrupt the production, instead of being, as is usual, hoisted and lowered by the winding engine.

The general details of the costs of realization of the gross values per ton of ore for the period under review showed, without making deduction for depreciation of mine or plant, as under:

Costs of mining and development	$5.55	per ton.
Railway transportation to smelter.....	.75	"
Cost of smelting to matte	5.59	"
Refining tolls and charges, and freight...	1.25	"
Breen's profit on smelting contract.....	2 00	"
	$15.14	

Subtracting the costs of realization from the average gross value of the ore, the first eight months operations showed a profit of $2.19 per ton on the production for that period, or a total of $98,915.73, while the last six months showed a deficit of $1.48 per ton, or a total deficit of $76,202.24 on the production of that period, which brought the profits for the 14 months down to $22,713.49

It should be noted as of particular significance, the general lowering of the average grade of the ore produced, and further, that the production of the last three months of the period under review, that is, October, November and December, had an average gross value of only $12.50 per ton, which made a working deficit to the company of $2.64 per ton for the ore produced during these months, notwithstanding the profits derived from the three-quarters interest in the smelter.

Such were the statistics furnished by the company's records for the first fourteen months of its existence. From these it was quite apparent that no profit could be earned unless the conditions under which operations were carried on were modified.

The Conditions.—At this time the mine was worked through a three-compartment incline shaft, sunk near the easterly end of the property on the variable dips of the vein, to a depth of 940 feet. In this shaft, at approximately 100 feet distant from each other, stations were cut and level drives run easterly and westerly in the vein. Along these drives stopes were opened and worked upwards in the ore bodies. The exhausted stopes were timbered by the square set system. The ore was stoped by drilling with machines run by compressed air, and by blasting with dynamite. The ore when blasted was shovelled into chutes, down which it gravitated to the levels, the larger pieces being sledged into sizes not exceeding 10 inches in diameter. From these chutes it was drawn off into steel push-cars having a holding capacity of from 18 to 22 cubic feet (about one ton of broken ore). These cars were pushed by the trammers to the shaft stations, and their contents dumped into the storage pockets cut under the stations. The storage pockets had a holding capacity of from 700 to 900 cubic feet, that is to say, 40 or 50 tons of ore each. From these pockets the ore was loaded into the hoisting skips and lifted to the surface by a double drum, direct acting hoisting engine, cylinders 20 x 42 inches. These skips dumped automatically at the surface, running in counter balance, the empty skip being lowered as the loaded one is hoisted.

On being dumped at the surface, the ore gravitated into a receiving car which was pushed along to the various distributing stations over the sorting floor, where it was dumped before the squads of ore sorters, whose duty it was to pick out the second class ore from the shipping ore and shovel the two classes into separate bins.

From these bins the ore was trammed in the receiving bins at the head oi the tramway, and the second-class ore was trammed to the second-class ore dump. From the receiving bins the ore was loaded into four-ton cars and run over a surface gravity tramway, 700 feet in length, with a fall of 250 feet, to the lower or loading terminal, where it dumped through a chute into the railway cars.

As each of the railway cars were loaded, it was moved by men and an empty one substituted, until a train of from ten to twenty 30-ton cars was made up. When, as often happened, there were no empty cars, all the men at the various stages in the passage of the ore from the stopes to railway cars, were thrown idle because there were no intermediate storages of sufficient capacity to hold the ore accumulating in the interval.

Under these conditions, and with the facilities and equipment briefly described above, the average output (250 tons per day) for the fourteen months under review, was hoisted from the mine, sorted and loaded on the railway cars

The details of the cost per ton of hoisting, sorting and tramming to and loading on the railway cars is given in the following table:—

TABLE I.

Hoisting—				
Fuel	8 tons @ $6 00	$48.00	$0.192	per ton.
Engineers	3 .... @ 4 00	12.00	0.048	"
Firemen	2 .... @ 3.00	6.00	0.024	"
Skiptenders	4 .... @ 3.50	14.00	0.056	"
Interest, depreciation & renewals		1.50	0.006	"
Oils and waste		.50	0.002	"
				$0.328 per ton.
Sorting—				
Foremen	2 @ $3.00	$6.00	$0.024	per ton.
Topmen	4 @ 2.50	10.00	0.040	"
Waste trammers	4 @ 2.50	10.00	0.040	"
Ore "	12 @ 2.50	30.00	0.120	"
Sorters	32 @ 2.50	80.00	0.320	"
Interest, depreciation, renewals and tools		1.50	0.006	"
				$0.550 per ton.
Tramming to Railway—				
Brakemen	1 @ $4.00	$4.00	$0.016	per ton.
Carmen	5 @ 2 50	12.50	0.050	"
Carmen at railway	3 @ 2.50	7.50	0.030	"
Interest, depreciation, renewals and tools		2.00	0.008	"
				$0.104 per ton.
Total cost				$0.982 "

After the mechanical handling of the ore produced as above described, the next item of cost attaching was 75 cts. per ton for railway freight between the mine and the smelter. This was the contract price made with the railway some three years before for all the ore to be produced by the mine for the term of five years.

On arrival at the smelter yards, the ore was dumped from the (bottom-dumping) railway cars into the receiving bins. From these it was loaded into push-cars and trammed to the roast yard and dumped over the roast heaps being built there, into which it was fed by shovelling—six men being required for this work. The crushed ore was elevated and put through the sampling mill. When sampled, the ore was again elevated to the "high line" bins. From these it was loaded into push-cars and trammed to the roast yard, and there on trestles over the roast heaps being built.

Table II following gives an itemized statement of the cost of the different handlings of the ore as above described, between the mine and the roast heaps, including the railway freight.

TABLE II.

Railway Freight—				
Under contract				$0.750
Unloading and Crushing—				
2 Dumpmen	@ $2.40	$4.80	$0.019	
6 Trammers to crushers	@ 2.50	15.00	0.060	
2 Crusher feeders	@ 2.50	5.00	0.020	
Repairs and renewals			0.050	
				$0.149
Sampling—				
1 Foreman	@ $5.00	$5.00	$0.020	
1 Sampler	@ 3.50	3.50	0.014	
1 Topman	@ 3.00	3.00	0.012	
1 Binman	@ 3.00	3.00	0.012	
Interest, depreciation and renewals			0.100	
Power			0.125	
				0.283
Tramming to Roast Yard—				
6 Trammers to roast	@ $3.00	$18.00	$0.072	
Depreciation and renewals			0.010	
				0.082
Total cost				$1.264

TABLE III.

Giving Summary of the Per Tonnage Costs attaching to the Ore for Hoisting; Sorting; Tramming to Railway; Loading on Cars; Railway Freight to Smelter; Unloading and Crushing at Smelter; Sampling and Elevating at High Line; Tramming to Roast Heaps.

250 tons possible.

Hoisting	Table	I.	$0.328
Sorting	"	I.	0.550
Tramming to railway	"	I.	0.104
Railway freight to smelter, contract	"	II.	0.750
Unloading and crushing at smelter	"	II.	0.149
Sampling and elevating to high line bins	"	II.	0.283
Tramming to roast heaps	"	II.	0.082
Total			$2.246

The costs of stoping, timbering and development work will not be considered here, although they were also indirectly and unfavourably affected to a considerable extent as to cost.

Extraneous Conditions.—While my investigation of the economical factors affecting the operation of the Le Roi was proceeding, that is,

during the first two months of 1900, new conditions were commencing to affect the mining industry of the Province unfavorably. The burdens of the eight-hour law passed by the Provincial Legislature during its session of 1899 were beginning to be seriously felt in Rossland, which was the only important district that continued mining work after the law became effective, paying the same wages for eight hours' work as was formerly paid for ten hours' work. The law had been in operation for the last eight months of 1899 and the returns were coming in a way that there was no mistaking the result. Careful calculations made by Mr. R. E. Palmer, chief engineer of the Le Roi mine during 1899 and part of 1900, and now assistant to Mr. W. A. Carlyle at the Rio Tinto mine, showed that the additional cost of operating the Le Roi since the eight-hour law became effective, amounted to a sum which added $0.72 per ton on the ore produced (250 tons per day).

During the same year (1899), contract work in the mines had been prohibited by the Miners' Union, and statistics showed that the mie costs during that year reached higher figures in the Rossland mines than in any other camp in the Rocky Mountain regions.

The Provincial Legislature during its session in 1900 passed a law doubling the tax which had previously been imposed on the gross output of metalliferous mines. Prior to this time the Provincial tax had been 1 per cent. on the gross value of the ore produced, less freight and treatment charges. This tax was raised to 2 per cent. on the same basis by the new law just passed.

It will, perhaps, be pardonable to digress for a moment, to say that the Mine Owner's Association protested vigorously against the passage of this law, pointing out that the regular annual addition of the new laws passed by the Provincial Legislature oppressive to the mining industry could only result in driving capital from seeking investment in the Province.

The law was passed, however, in disregard to the mine owners' protest and representations, and, I regret to say, the results then pointed out have come to pass. The mining industry, vigorously commenced in the early '90's in a new undeveloped mineral region of exceptional promise, should have advanced by leaps and bounds, but it has barely held its ground, and while the tonnage produced has increased in some instances, the dividends are few and far between.

Thus stood the economical conditions affecting the operations of the Le Roi mine in February, 1900, two months after the writer had assumed its management. The prospect was not very bright; in fact, it was very gloomy. All the per tonnage expense of mining, development, depreciation, renewals, hoisting and delivering the ore to the roast heaps at the smelter, government taxes, smelting ore to matte, loss in smelting operations, freight charges on matte to Eastern refineries, refiners' tolls and charges, interest and discounts, and Breen's profits of $2 00, amounting to $15.15, had to be paid from the gross values in the ore, which had fallen to an average of $12.50 per ton during the last quarter of 1899, and the balance was expected to be—profit, to pay dividends to shareholders.

Facts to be determined.—It could not be expected that the metals in the vein would reverse the persistent and natural tendency they manifested from the surface to the 800-ft. level already noticed, and become concentrated into smaller and richer streaks such as were found near the surface.

The average character and grade of the ore in the vein already found to exist below the circulation of surface waters was the best that could reasonably be hoped for in the deeper levels, that is the metals would be found distributed more or less uniformly throughout the entire width of the vein-filling in the deeper levels, which meant a larger tonnage and a lower-grade ore. Future operations would have to deal with these facts intelligently if they would be profitable.

The experience of the previous fourteen months, wherein 96,000 tons of ore were mined and smelted leaving practically no profit showed how futlle it would have been to continue operations on the same scale in the face of a lower average grade of ore than was dealt with during that time. Could existing conditions be modified so as to make operations profitable? This was the problem which had to be solved affirmatively or the mine abandoned, for the company could not be expected to continue operations while making a loss of from $2.00 to $3.00 per ton of ore produced.

Of the numerous factors required for the solution of this problem, the main one was the determination of the quantity and grade of the ore in the mine, and the probability of its downward continuation. This was the one which had to be more or less accurately determined before it was worth while to consider the others.

In due course it was ascertained that there were approximately 1,000,000 tons of ore in sight in the mine, having an average gross assay value of $12.50 per ton, and it was considered probable that the ore bodies would extend indefinitely downward. The problem, thus simplified, then appeared as follows:—

Can the costs of realization, now $15.14, be so reduced as to leave profit on the $12.50 ore; and if so, what profit can be reasonably expected?

Contingent Calculations.—Proposed Plans.—Careful calculations showed that the costs of realization might be reduced to $8.00 per ton providing an expenditure of about $1,250,000.00 was made on new development and equipment of the mine, and increase of the capacity of the smelting plant. This expenditure provided for:

1. Freedom of the company from dictation of the Miners' Union so that, by the re-establishment of the contract system, the company could contract its work to the best workmen, and would have to pay only for the work actually done, instead of the time spent in doing it.

2. The purchase of Breen's one-fourth interest in the smelter, and his contract for smelting the ore.

3. The sinking of a five-compartment shaft on the mine, and the erection of a modern plant of hoisting machinery and handling facilities at its head, of adequate capacity for an output of 1,000 tons per day of 10 hours.

4. To enlarge the Northport smelter so as to have a marginal capacity of from 400 to 500 tons daily for custom ore, in addition to that required for smelting the increased production of the Le Roi, viz., a total capacity of 1,500 tons per day.

Difficulties Overcome.—When the position of the company, as above described, was fully understood by its directors, I was authorized to carry out these plans if the necessary financial arrangements could be provided for from the operation of the property.

The difficulty of making satisfactory arrangements for financing the company seemed, at first, almost insurmountable—the chartered banks of the Dominion being compelled by law to lend money to mining companies only on the security of liquid assets such as ore on dump or in stock in smelter yards or furnace products in transit. This required a margin of production over and above that required to finance the normal mining and smelting operations, sufficient to meet the cost of the new work.

Fortunately, however, this difficulty was soon solved. A two-compartment winze sunk on the vein from the Black Bear tunnel to the mine workings on the 700-ft. level was equipped with a 150 h.p. electric hoist and pressed into service as an auxiliary shaft. All mining timbers and supplies, the general mining traffic and the miners going to and from their work, passed through this new outlet. This relieved the congestion at the old shaft so that it was soon posssible to almost double the ore production. The output was immediately increased to

an average of 443 tons per day, and later on to 600 tons per day, which gave the desired margin of unincumbered ore available for security for the funds required for the proposed improvements, which could now proceed as rapidly as desirable.

The option previously obtained to purchase Breen's interest in the smelter for $300,000.00 was exercised, this sum being borrowed from the bank. This left the company the complete owner of the smelter and all the profits on the smelting operations, which reduced to it the costs of realization to $13.14 per ton, except the deduction for interest on the $300,000.00 borrowed.

The proposition to introduce the contract system in the mine was next tackled. This was vigorously opposed by the Miners' Union, who refused to allow their members to work by contract. The mine was, in consequence, closed down for a period of 66 days. At the end of which time the Union consented to allow their members to work by contract, as proposed, and the mine was re-opened under freedom to utilize this system.

The results proved very satisfactory to the company and to its employees as well. The possibility of earning wages commensurate with skill and experience attracted the best miners from surrounding camps. In the hands of skilful miners, the maximum capacity of the machine drills was soon reached, and with the increase of output came a general lowering of costs, although the miners continued to earn more than the standard scale of wages.

A suitable location for the five-compartment shaft had been selected and its construction commenced. Simultaneously, the excavation for the foundations of the several units of the proposed new plant was begun, as was also the preliminary work for increasing the capacity of the smelter. During the later part of March, or the early part of April, all the necessary preparations were made, and the work of constructing the new plant commenced.

The Mining Plant.—The general arrangement of the several units of the new plant, as completed, is shown in plate —, made from a "winter scene" photograph. This arrangement was suggested by the local topography, the accessibility of the railway spurs and the necessary isolation of the independent units from each other, to minimize the risk of fire communication between the several buildings.

On the plate, 1, is the head works at the combination shaft; 2, the compressor building; 3, the boiler plant; 4, the ore bins at railway; 5, the stores building; 6, the blacksmith shop; 7, the machine shop; 8, the carpenter shop and timber framing shed; 9, the portal of Black Bear tunnel, which connects with the combination shaft at a depth of about 300 feet; 10, the Great Northern Railway; 11, the cooling reservoir; 12, the aerial tramway.

Inasmuch as a detailed description of the several units comprising this plant would be very lengthy and, perhaps, too tedious, I will content myself with the following brief description of them, referring only to their more prominent features.

Boiler Plant.—This plant consists of nine horizontal, return tubular, steel shell, high pressure boilers, set in three batteries of three boilers each; and two Heine Safety Water Tube boilers set in one battery.

In the aggregate, this plant has about 2,000 nominal horse power —sufficient to supply the steam necessary to operate all the machinery connected with the mine and have one of the four batteries out of service. The spare battery is always held ready for steaming when any of the others in service require cleaning or repairs. This plant is modern and complete in all its details, and is equipped with all the most improved devices (except mechanical stokers) to provide for safety and continuity of operation at the lowest cost for attendance and maintenance.

The selection of the site chosen for this plant was suggested, (1) by its accessibility from the high line spur of the railway from which the coal is delivered to the storage bunkers behind the building; (2) because of its safe distance from the other units, in the event of fire originating in it; (3) convenience to the large cooling reservoir, where the steam pumps for fire protection and pumping back the water for condensing purposes, are located.

Steam is transmitted from this plant to all the steam engines through a series of insulated steam lines. A 9-inch steam line, carrying steam at 140 pounds pressure, connects with the two air compressors. Two additional steam lines run through the Black Bear tunnel and connect with the hoisting engines at the head works of the combination shaft. One of these is an 8-inch and the other a 6-inch line, the 8-inch line being the one generally used, the 6-inch being held in reserve in case of accident to the 8-inch line.

Each of these lines is insulated by two layers of cellular asbestos covering, and provided with the requisite number of steam traps and expansion joints. This arrangement of concentrating the boilers into one suitable location and transmitting the steam to the separate units of the plant, gives greater economy, satisfaction and security from fire than could be obtained if separate boiler plants were installed adjacent to the engines requiring the steam.

Air Compressing Plant.—This plant consists of two compressors, one having 22 x 36 x 48 inch cross compound condensing steam cylinders, with 22 x 36 x 48 inch two stage air cylinders; the other, 22 x 36 x 48 inch, with cross compound condensing steam cylinders, with 22 x 38 x 48 inch two stage air cylinders. The combined capacity of these two machines is 8,000 cubic feet of free air per minute at sea level, compressed to 95 lbs. gauge pressure.

One of these compressors was installed during my management, and the other installed by the old company in 1896, but this latter was remodelled in some essential details at the time of the newer installation. Both compressors were built by the Canadian Rand Drill Co., and both have given entire satisfaction, although in economy and efficiency there is a very marked difference in favor of the latter installation. It is very interesting to notice the improvements made in the manufacture of this class of machinery in the four years that transpired between the building of the first and second of these machines.

The operation of this plant has proven very economical, a working test extending over a period of thirty days during ordinary working conditions showed a coal consumption of 1.9 pounds per horse power per hour, and that air was being compressed to 95 pounds per square inch at the low cost of $1.59 per each 100,000 cubic feet of free air compressed. This calculation did not include the interest on the investment or depreciation, but all other costs.

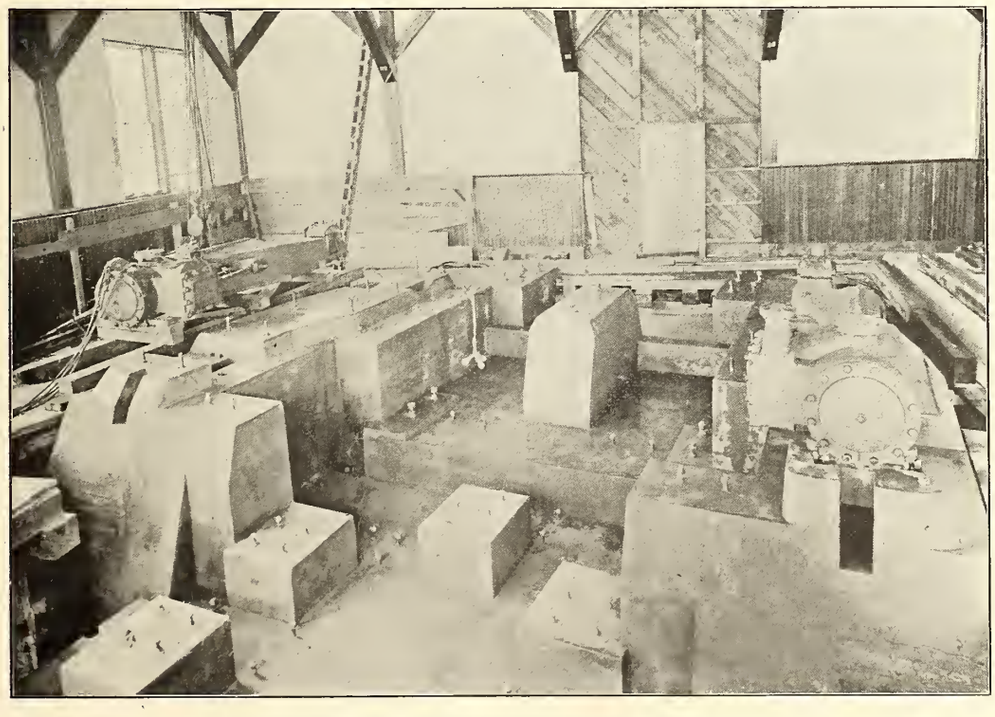
The air compressed by this machinery is transmitted into the mine workings through a series of air receivers and two pipe lines. The air receivers consist of boilers rejected from the old steam plant and erected in the open air immediately outside the compressor room. The two pipe lines leading from these receivers extend to the bottom of the mine workings, and consist one of 8-inch and the other of 6-inch pipe, with branch lines leading off, carrying the compressed air to the workings on the various levels.

The extensive cooling surface afforded by the number of tubes in the boilers thus converted into receivers, permits of the condensation of the moisture contained in the condensed airs; besides, the long, ample pipe lines in themselves serve as a second series of receivers, passing through which most of the moisture contained in the air is condensed and precipitated, to be blown off as it accumulates in the receivers placed on every working level in the mine. The air, thus drained of its contained moisture, goes to the drills and the pumps in

HOISTING AND HAULAGE PLANT AT THE LEROI MINE, ROSSLAND, B.C.



City of Rossland, B.C., showing Headworks of the LeRoi Mine and Mount Roberts, with fog cloud intervening. Taken from Columbia Avenue.



Concrete Foundation ready to receive General Traffic Hoist.

the best condition for service, and freezing of the machines driven by it is unknown.

Hoisting Plant.—This plant, installed at the head works of the combination shaft, consists of two modern types of first motion winding engines, one of 1,000 and the other of 500 nominal horse power. The larger hoist is the standard Allis-Chalmers design, with some special features incorporated to meet our views. This engine is used exclusively for hoisting ore, and is not called upon to do any of the general traffic of the mine. Devoted to this specialty, its efficiency and capacity is increased, as the engineer has only thisspecial work to perform and is not confused by the call signals for other purposes.

The smaller hoisting engine consists of a pair of 20 x 30 high pressure engines, and is equipped with four auxiliary engines, with which the clutches, reversing gear and brakes are handled.

This engine was especially designed for the rapid and safe hoisting and lowering of men, and the general traffic incidental to the mining operations, and is exclusively used for these purposes.

Heating Plant.—This consists of a Sturtevant fan heater, and heats the headworks and sorting room by heat generated from the exhaust steam of the hoisting engines.

Combination Shaft.—This shaft, having dimensions of 27½ x 6 feet clear of outside timbers, is sunk on the average dip of the vein, 69° from the horizontal, to a depth of 1,125 feet (June 30th, 1901).

It is divided into five compartments, two of which are used exclusively as roadways through which the ore is hoisted from the pockets at the stations on the varions mine levels and delivered to the crushing machinery at the headworks; the two adjoining ones being used for the general mine traffic, that is, hoisting and lowering men, timber, tools and mining supplies; the fifth compartment being used as a manway and for the compressed air and water pipes, and electric wires.

From the hanging wall side of the shaft at the various levels, stations have been cut to accommodate the general traffic of the mine. Underneath the floor of these stations, pockets are excavated having a holding capacity of about 500 tons each. These pockets are used to receive and store the ore trammed from the stopes until it is suitable to hoist it.

At the 900-ft. level, a large catch basin or water tank having a holding capacity of 50,000 gallons, has been excavated in the solid rock in the footwall side of the shaft. This tank receives all the water flowing from the various parts of the mine. Over it the mine pumping plant is installed, and the accumulated water is lifted a height of 600 feet to the Black Bear tunnel, through which it flows to the surface.

The four hoisting compartments in the shaft are tracked with 36-lb. "T" rails and provided with timber guides, to prevent the hoisting skips from leaving the track.

Head Frame at Shaft.—This is 85 feet high from the collar of shaft to the bearings of the sheaves, and is built of Douglas fir in a very substantial manner, calculated to withstand the strains due to the rapid lifting of heavy loads from a state of rest by the two hoisting engines.

The ore hoisted is dumped automatically on grizzlies set in the head frame at a height 65 feet above the collar of the shaft. The delivery of the ore at this height provides sufficient elevation for its automatic passage by gravity over the grizzlies and through the crusher into the storage bins beneath, from which it is delivered, by automatic feeders, to the Sorting Tables.

Crushing, Sorting and Sampling Plant.—This plant occupies in part the building enclosing the head frame at the combination shaft, and continues into a wing extending from it 100 feet in length by 30 feet in width and three stories high.

The machinery of this plant was especially designed for the crushing, sampling and sorting of ore in continuous operation as comes from the mine, completely preparing it for smelting operations.

The transportation and handling of the ore from the time it is broken in the stopes to its delivery in the smelter yards, is briefly described as follows:—

The ore, when blasted down in the stopes, is broken into pieces of suitable size, say 10 inches in diameter, shovelled into chutes, and from them trammed to the storage pockets at the combination shaft.

From these pockets it is drawn off into the hoisting skips through chutes opened and closed by steel gates, actuated by compressed air cylinders. By these means the ore is loaded rapidly and cheaply, it only requiring a few seconds to fill a four-ton skip.

The loaded skips, holding 4 tons, are hoisted to the surface and dumped automatically over the grizzlies, which are arranged to divide the ore into three classifications. The size too large to fall through the grizzly bars, gravitates over them to Comet crusher, set to crush to 4-inch sizes, the largest size suitable for the subsequent sampling and the smelting furnaces. The fines falling through the grizzly bars pass directly to the "fines" receiving bin, from which it is automatically fed to a conveying belt and carried to the sampling machinery without sorting.

The ore passing through the Comet crusher falls into the "coarse" receiving bin, from which it is fed automatically to two endless conveying belts. These belts, including the belt carrying the fine ore, are each 100 feet in length between centres, and adjusted to travel at the rate of 45 feet per minute. On either side of the two belts carrying the coarse ore the sorters are stationed, who pick out the waste and second-class ore, allowing the shipping ore to be conveyed past them to the sampling machinery.

On falling from the conveying belts, the ore passes through the sampling machinery, consisting of three Constandt cone samplers, a Blake crusher, Cornish rolls, Bridgeman sampler, small Comet crusher and small Bridgman sampler, where a uniformly proportional sample for assay is "cut out" and quartered, ready for the assay office.

The sorted ore, after passing through the sampling machinery, falls into a storage bin, having a holding capacity of 1,000 tons. This bin was intended to hold in storage the production of the mine for 24 hours, in case of accident or repairs needed for the aerial tramway, which could be stopped for 24 hours without interfering with the mining operations.

All the operations of hoisting, screening, crushing, conveying and sampling the ore in its passage from the pockets at the shaft stations in the mine to the railway cars, is automatically conducted, and the cost of this work, as may be seen from Table IV, is reduced to a very low figure.

Electricity is the motive power used for driving this plant, one 150 horse power induction motor driving the Comet crusher and one 125 horse power synchronous motor driving all the rest of the machinery. This power is supplemented by a 250 horse power Corliss engine, to be used as the motive power for driving the machinery in case of accident to the electric motors. The electric motive power has given very satisfactory and economical results

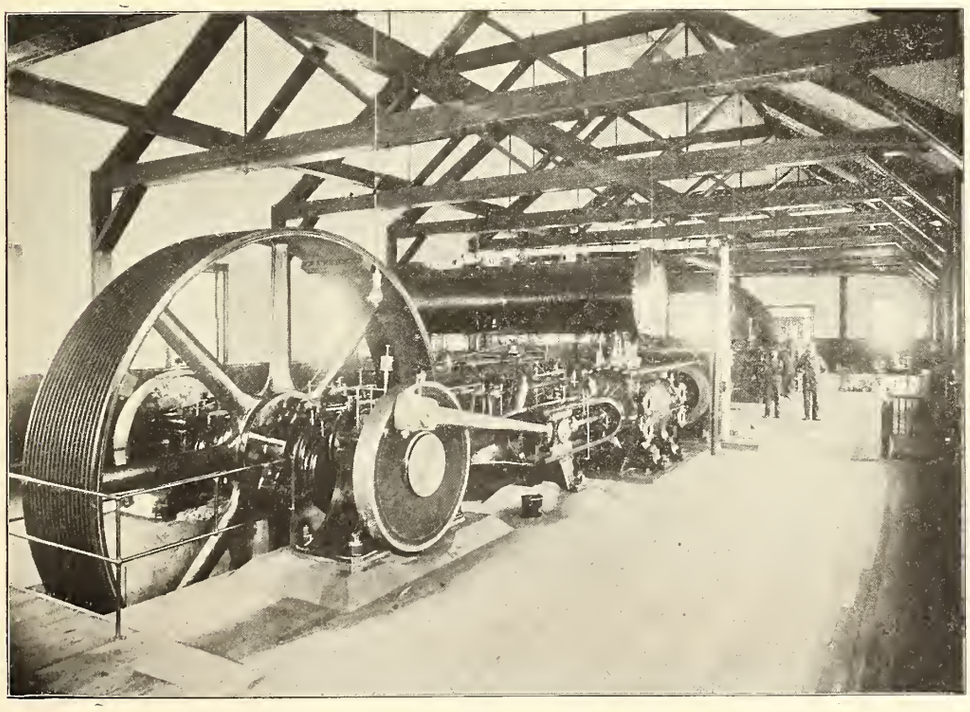
Ore Bins and Aerial Tramway.—When the ore is crushed, sorted and sampled, it falls into a bin having a holding capacity of 1,000 tons. This bin is situated under the sampling mill, and is equipped with a delivery chute, which is opened and closed by a steel gate attached to the piston of an air cylinder, embodying the same principle of construction as the chutes from the pockets in the combination shaft.

The ore is fed through this chute into an automatic loading device, which loads the buckets of the aerial tramway while in motion. This

HOISTING AND HAULAGE PLANT AT THE LEROI MINE, ROSSLAND, B.C.



General arrangements of the several units of LeRoi Plant.—1. Headworks at the Construction Shaft. 2. Compressor Building. 3. Boiler Plant. 4. Ore Bins at Railway. 5. Stores Building. 6. Blacksmith Shop. 8. Carpenter Shop. 7. Machine Shop. 8. Carpenter Shop and Timber Framing Shed. 9. Portal Black Bear Tunnel, which connects with Black Bear Tunnel at a depth of about 300 feet. 10. Great Northern Railway. 11. Cooling Reservoir. 12. Aerial Tramway.



Interior of LeRoi Compressor Building.

device is operated by one man, who easily loads and controls the travel speed of the tramway, so as to deliver 120 tons per hour at the terminal bin at the railway.

The Aerial Tramway is of the two rope system—one stationary, carrying the sheeve wheels from which the buckets are suspended; the other hauling them and controlling their speed. It was built by Mr. B. C. Riblet, and has numerous patent devices owned by that gentleman. The attachment of the compressed air cylinder for operating the loading chute was designed by the writer, and is said to be the only tramway equipped with that device. There are 26 buckets attached on the moving rope and spaced on it 65 feet apart. This rope has a speed travel of 268 feet per minute. The buckets have a holding capacity of 10 cubic feet, or 1,000 pounds of crushed ore, and are arranged to dump automatically at the railway terminal bin. Only the one man who operates the automatic loading device and the brake at the loading terminal is required to operate this tramway to its full capacity.

As the ore dumps in the terminal bin at the railway, it falls on grizzlies, the bars of which are spaced 1½ inches apart, and set at an angle of 40° over the centre compartment of the bin.

In passing over the grizzlies, the ore is screened into two classes, coarse and fines. The fines, passing through the grizzlies, fall into the centre compartment of the bin, the coarse, gravitating over the grizzlies, goes to the outside compartments. This separation gives the classification desirable for building the heaps for roasting at the smelter. This bin has a holding capacity of of 1,600 tons of crushed ore, and, as above indicated, is divided into three compartments, the centre compartment holding the fines, the two outside compartments the coarse ore.

The ore from these compartments is loaded into the railway cars through triple chutes, one triple-mouthed chute leading from each compartment. These chutes are opened and closed by compressed air lifts, and operated by one man.

A train of from 20 to 25 empty cars, each of which has a holding capacity of from 30 to 40 tons of ore, are "spotted" at these bins by the engine, which also moves each car of the train under the spouting apron of the chutes as required. It requires less than a minute to fill a car from this bin.

It may be explained here that when the plans for increasing the output of the mine were made known to the officials of the Great Northern Railway, they consented to modify the contract existing with the company by reducing the freight rate to 40 cents per ton, on an output of 1,000 tons per day being maintained.

The ore is hauled to the smelter in bottom dump cars, which empty their contents into the ore bins set under the spur track recently built. This spur track and the ore bins built under it are part of the recent construction for increasing the smelter's capacity and cheapening the handling of the ore there. From these bins the ore is drawn off into push-cars and trammed directly to the roast heaps. The repeated handlings of crushing, sampling and elevating formerly required to be done at the smelter being unnecessary now since all that work is done at the head works of the mine automatically by the machinery installed there. Thus it will be seen that the ore is taken from the pockets of the mine, hoisted and conveyed through the crushing and sorting processes, trammed to the railway, loaded on to trains and then hauled to the smelter yards, all by machinery and with the least possible handling in transit.

It is hypothetically possible for the ore to pass from the pockets at the 900-ft. level of the mine to the roast heaps at the smelter, 18 miles distant, in 1 hour 41 minutes 8 seconds, this time being occupied between the various stages of passage as follows:—

	H.	M.	S.
Loading in skip at 900-ft. level	..	..	05
Hoisting and dumping at surface	..	..	30
Crushing and feeding to travelling belts	..	..	10
Passing over travelling belts before sorters	..	2	18
Gravitating through sampling mill machinery to bins beneath	..	..	05
Loading buckets of tram and delivering to bins at railway	..	3	..
Loading on railway cars	..	1	..
By rail to smelter, 18 miles	1	30	..
From smelter ore bins to roast heaps	..	4	..
Total	1	41	8

In ordinary operations this speed is modified by the length of time any given quantity of ore rests in the bin storages provided between the different stages of progress from the 900-ft. level of the mine to the roast yards at the smelter. In fact the pockets at the various levels in the mine or the storage bins underneath the crusher or at both terminals of the aerial tramway are seldom empty, a condition that would be necessary to effect the travel speed given in the above table.

The costs of hoisting, crushing, sorting, sampling, aerial tram to railway, loading on railway cars, railway haulage to smelter and distribution to roast heaps, of 1,000 tons of ore daily between the pockets in the mine and the roast yards at the smelter, as above described, is given in Table IV. following:—

TABLE IV.

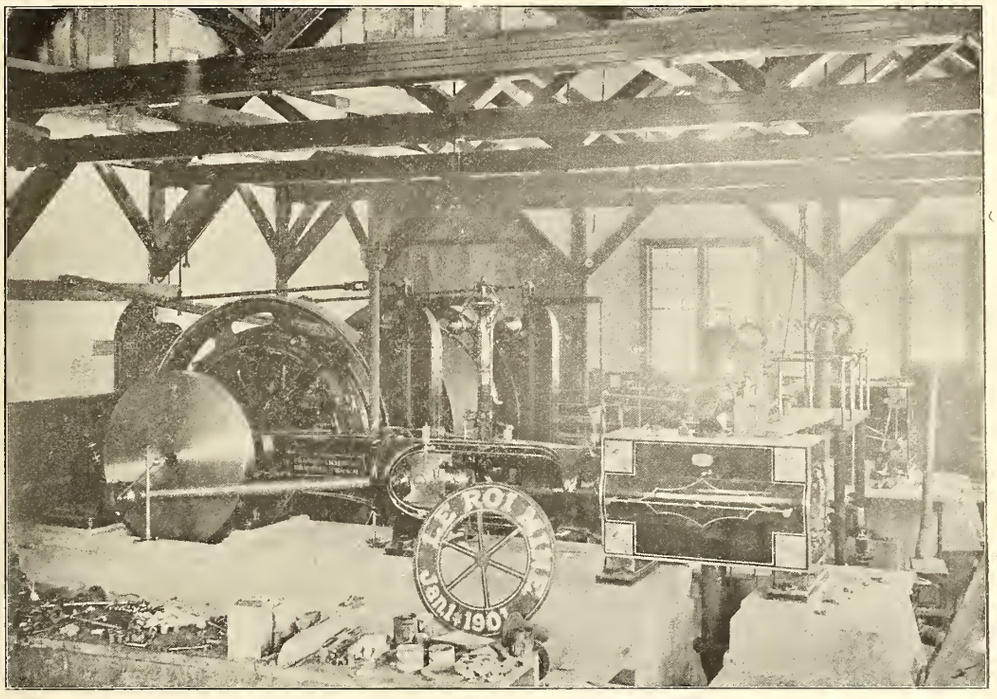
				Per Ton.
Hoisting—				
Fuel, 10 tons	@ $5.75 per ton	= $57.50 per day or		$0.0575
Foremen	2 @ 3.00 per day	= 6.00 " "		0.0060
Engineers	2 @ 4.50 "	= 9.00 " "		0.0090
Wipers	1 @ 3.50 "	= 3.50 " "		0.0035
Skip tenders	2 @ 3.00 "	= 6.00 " "		0.0060
Interest, depreciation and renewals		4.40 " "		0.0045
		$86 50 "		$0.0865
Crushing, Sorting, Sampling—				
Foreman	1 @ $5.00 per day	= $5.00 per day or		$0.0050
Crushermen	1 @ 3.00 "	= 3.00 " "		0.0030
Sampler	1 @ 3.50 "	= 3.50 " "		0 0035
Oilers	1 @ 3.00 "	= 3.00 " "		0.0030
Sorters	30 @ 2.50 "	= 75.00 " "		0.0750
Oil and waste		1.00 " "		0.0010
Electric power		10.00 " "		0.0100
Interest, depreciation and renewals		2.00 " "		0.0020
		$102.50 "		0.1025
Aerial Tram to Railway—				
Tram runners	1 @ $4.00 per day	= $4.00 per day or		$0.0040
Interest, depreciation and renewals		5.00 " "		0.0050
		$9.00 "		0.0090
Loading on Railway Cars—				
Spouting into cars, attendance		$0.50 per day or		$0.0005
		$0 50 "		0.0005
Haulage—Railway to Smelter		$400.00 " "		$0.4000
		$400.00 "		0.4000
Distribution to Roast Heaps—				
Foreman	1 @ $4.00 per day	= $4.00 per day or		$0.0040
Trammers	15 @ 3.00 "	= 45.00 " "		0.0450
Interest, depreciation and renewals		11.00 " "		0.0110
		$60.00 "		0.0600
Totals		$658.50 " per ton		$0.6585

In Table V following, is given a comparison of the Per Tonnage Cost of hoisting, sorting, crushing, sampling, tramming to railway and loading on cars, railway haulage to smelter and distribution of ore to the roast heaps, as done with the old machinery and facilities, and that done by the new plant.

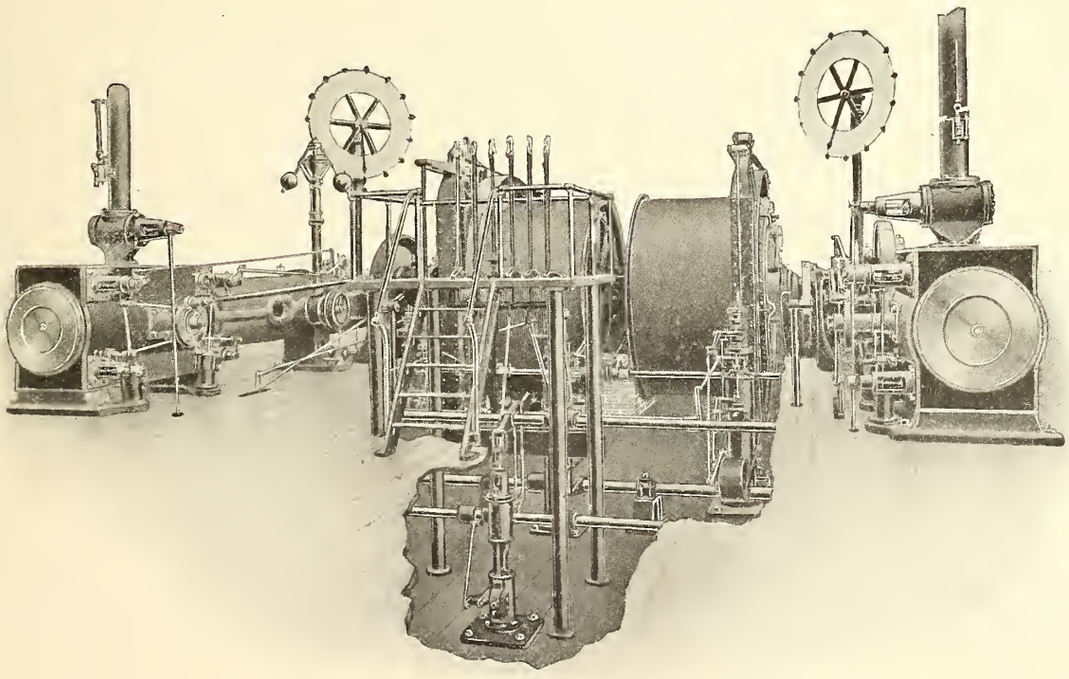
TABLE V.

	Old Machinery.	New Machinery.	Difference in Favor New Machinery.
Hoisting—Tables I, III, IV	$0.3280	$0.0865	$.02415
Crushing, sorting, sampling—Tables II, III. IV.	0.9820	0.1025	0.8795
Aerial tram to railway	$0.0005		
Loading (spouting) railway cars.	0.1040	0.0090	
Tables I, IV		0.0095	0.0945
Haulage, railway to smelter—Tables II, IV	0.7500	0.4000	0.3500
Tramming to roast heaps—Tables II, III, IV	0.0800	0.0600	0.0220
Totals	$2.2460	$0.6585	$1.5875

HOISTING AND HAULAGE PLANT AT THE LEROI MINE, ROSSLAND, B.C.



LeRoi Winding Engine in course of installation.



Description of Hoisting Engine built for the LeRoi Mining Company.—This engine embodies the latest principles in hoisting engine construction, and consists of two 24-inch by 60-inch Corliss Engines with two drums 10 feet diameter by 5 feet face mounted directly on the crank shaft. Each drum is equipped with a powerful band friction clutch and a powerful post brake operated by steam. The engine is provided with special valve gear for hoisting engine work, and is controlled by link reversing gear operated by an auxiliary engine. It is furnished with all devices for proper handling and safety. Maximum capacity 14,500 lbs. unbalanced load raised at 2,000 ft. per minute with 100 lbs. steam pressure.

From this Table the following deductions may be made :—

Daily	Saving effected on output of 1,000 tons	$	1,587.50
Monthly (25 days)	" " "		39,687.50
Yearly (300 days)	" " "		476,250.00

In connecction with the installation of the hoisting and haulage plants above described, various accessory facilities, including railway spurs, have been constructed, which have materially cheapened the costs of realization that have previously prevailed. A general description of some of these follow, but the economies effected are not given, as the main object of the paper is to describe the new system of hoisting and haulage at the Le Roi mine and the economies effected by it, as compared with the old system.

Carpenter Shop and Framing Shed.—Here all the mine timbers are delivered from the railway cars, aud are framed to square sets by machine saws, of which there are two sets, each complete in itself. The high line spur of the railway is on a level with this plant, so that the timbers roll directly from the cars to the framing saws. When framed the timbers are loaded on the timber trucks, run through the Black Bear tunnel to the station at the combination shaft, there loaded on the cages and lowered to the different levels in the mine. The mining timbers are thus handled and framed in a most economical manner, and a very material saving is effected on the cost of wagon haulage and hand labor by which this work was formerly done.

Blacksmith and Machine Shops.—These adjoin each other, and are furnished with modern designs of forges, power hammers, lathes, shears and the general equipment necessary for the repairs and maintenance of a plant of this character. The forges and machinery for these shops, as well as for the carpenter shop and framing shed, are run by compressed air or steam. These shops are on a level with the railway, and all supplies used are delivered directly from the railway cars.

Powder Magazine.—A new fire-proof powder magazine has been built of stone and brick, alongside the high line spur that passes the portal of the Black Bear tunnel, blacksmith shops, etc., at a convenient though reasonably safe distance from the works.

Thawing House.—On the same track, and midway between the Black Bear tunnel and the powder magazine, a thawing house, equipped with steam heat, has been built. This is reached by the mine cars, which carry the thawed powder directly to the Black Bear station in the combination shaft, from which it is sent to the various levels as required. These arrangements do away with the cartage and consequent risk incidental to the extra handling of the powder, the importance of which will be recognized when it is known that the amount used daily in the mine approximates 2,000 pounds.

Water Supply and Fire Protection Systems.—A complete system of water supply for the machinery and for protection against fire has been installed, and, as a consequence, a very material reduction in the rates of insurance has been effected. The systems are a combination of the gravity and pumping systems, each supplementing the other. The gravity system operates under a head of 300 feet, and the pumping is done by two Standard Underwriter's pumps having a capacity of 500 gallons per minute each against a 400-ft. head.

The arrangement of these systems, which includes 31 hydrants strategetically located around the various buildings, is such that a very efficient fire service can be maintained with very little cost to the company, and the safety of the plant from fire may be considered assured if ordinary precautions are taken.

On the completion of this plant, the insurance companies made a reduction of 40 per cent. in the premiums previously paid for insurance.

The construction of the entire plant as above described was not finished until the month of May, 1901, although many of its units had been completed and utilized in the mining operations several months before. Owing to the industrial activity that prevailed during the period of construction, it was almost impossible to close a contract for the delivery of machinery of any considerable size short of nine or ten months from date of signing contract. This and other factors prolonged the time occupied in construction to double what would have been sufficient under favorable conditions.

The working of the completed plant was successul from the start, and the results shown in the preceding tables have been taken from actual operations.

Smelting Plant.—The enlargement of this plant had kept pace with the facilities provided at the mine for the increased extraction of ore, and in the month of May five furnaces, having a total capacity of 1,250 tons per day, were erected. The sixth furnace was on the ground ready to erect, which would have brought the total daily capacity of the smelter up to about 1,500 tons.

For the purposes of this paper it will not be necessary to give a description of the smelting plant, except to mention its increased capacity and the facilities afforded for handling the increased output of the mine. In the installation of the mining and smelting plants, great care was exercised in the choice of such machinery as was best adapted for the work to be done, while every portion of the plant was constructed with a view of obtaining the highest possible efficiency and economy in operation at the lowest cost.

The saving effected in the hoisting and haulage operations of this plant is worthy of the attention of mining engineers, for, as shown in Table V, this alone would make a very considerable profit on the mining operations, if conducted on a large scale.

All the cost of installation of the mining and smelting plants, and the purchase of Breen's quarter interest in the smelter was paid from the profits of the mining operation for the eighteen months ended June 30th, 1901, besides leaving a balance of $135,132.79 unencumbered product at the smelter.

The followtng statement, Table VI, shows the cost of these plants, and hence the profits earned during the period named:

TABLE VI.

Smelter—		
Cost of James Breen's smelting contract and one-quarter interest in smelter	$300,000 00	
Cost of interest paid on this amount	10,785 75	
" New smelter additions and handling facilities	185,442 00	
The total cost of the smelting plant		$496,227 75
Mine—		
Cost of 1,125 feet combination shaft, mine development and exploration	$292,426 40	
Cost of new mining machinery	210,086 05	
" " buildings enclosing the plants	99,311 13	
" underground machinery and equipment	64,453 45	
The total cost of mine development, machinery and equipment		666,277 03
The total cost of mining and smelting plants		$1,162,504 78
On hand at smelter, ore and furnace products, unencumbered as security to Bank		135,132 79
The total net earnings for eighteen months		$1,297,637 57

Eeonomies Effected.—As indicating the extent to which the costs of realization of the gross values in the ore may be reduced under full operations of the new mining and smelting plants, Table VII, giving the costs for the fiscal year ended June 30th, 1901, follows:—

TABLE VII.

Mining—			
Stoping	$3.362	per ton	
Exploration	.138	"	
Equipment	.094	"	
Depreciation of buildings	.030	"	
Depreciation of machinery	.106	"	
Freight on ores	.510	"	
			$4.420 per ton.

Smelting—

Matting ores	$4.252	per ton.
Depreciation smelting plant	.100	"
	4.352	"

Realization of Smelter Product—

Interest and discount	$0.145	per ton.
Eastern representative	0.027	"
Sacking and crushing matte	0.044	"
Freight on matte	0.536	"
	0.752	"
Making the total cost of realization	$9.344	"

In the foregoing table, the costs of realization show a reduction of $5.80 per ton under the costs prevailing while Breen owned the quarter interest in the smelter, or $3.80 per ton not counting Breen's profit of $2.00 per ton of ore smelted.

For the year reviewed, in Table VII, the mining operations had comparatively little benefit from the completed plant, although it must be acknowledged the saving effected by the several units of it completed earlier in the year, was very material.

Nevertheless, with the full benefit of the completed plant, a still further reduction in the costs of realization may be confidently expected and while the direct saving effected by the new hoisting and haulage plant is only $1.5875 per ton over that of the old machinery, it will be readily seen that the saving effected in the other departments on account of the high capacity and efficiency of this plant is solely, though perhaps indirectly, attributable to it. In other words, the hoisting and haulage plant and the incidental facilities installed on the Le Roi mine have made possible whatever reduction under $13.14 can be made in the costs of realization. It has been shown that with only part of the plant in operation during the year 1900-'01, the reduction amounted to $3.80 per ton. And it is reasonable to expect that with the larger output now possible, the operations will show a still further reduction of costs in all departments.

Concluding Remarks.—The data collected in this paper show that for effecting the highest economy in mining operations where a large output can be maintained, the following equipment and facilities should be provided:—

1. An efficient and up-to-date system of hoisting and haulage.

2. Such incidental facilities as will ensure, as nearly as may be, the contiouous operation of every plant comprising this system.

3. Intermediate storages of ample capacity for ore, in the mine and between the different sections of the plant, to provide against the stopping of the entire plant if an accident to any one section occurs.

4. Separate hoisting compartments for the ore, and for the general traffic of the mine.

5. All loading from the storage bins to be done through chutes opened and closed by compressed air.

6. Where hand sorting of ore is advisable, it is to be done on travelling tables of steel or rubber passing before the sorters at a speed not exceeding 45 feet per minute.

7. The waste and second grade ore to be picked out and dropped into bins underneath the sorting floor, the sorted ore to be allowed to be delivered to the sampling machinery automatically.

8. The boiler plant to be installed not nearer than 200 feet to any of the other units of the system and at a point, if possible, where the storage of a reasonable quantity of whatever fuel is used can best be effected.

9. A convenient grouping of the various units of the surface plant adjacent to the entrance of the mine, which should be accessible by railway, or by an easy system of wagon roads.

10. An efficient system of fire protecton operating preferably by gravity, or a combination of gravity and pumping. If the latter is used sufficient tank storage should be provided, so that, in case of fire breaking out, water under sufficient pressure will be available at once while the pumps are being started.

These features, so far as possible, have been kept in sight in the design and construction of the plant, herein described.

Before closing this paper, I feel it my duty to state that in the design and construction of this plant, I was ably assisted by Mr. William Thompson, who occupied the position of Assistant Manager with the company.

KLONDYKE BONANZA.

From the *Klondyke Bonanza* Directors' Report we extract the following:

The net profit made during the past year amounted to £3,667 7s. 11d., out of which the directors recommend the payment of a dividend of 1s. per share, being at the rate of 5 per cent. per annum *free of income tax.*

Nothing has been heard of the late manager, Mr. Lewis J. Macfarlane, since he left London in January last, but the directors have recovered the scertificates for the 5,000 bonus shares alloted to Mr. Macfarlane and propose to forfeit the same. His debt to the company is £3,010 2s. 6d., and, under the directors' instructions, the company's solicitors took legal steps against Mr. Macfarlane's estate in Scotland, but on his property (which is a large estate in the Highlands) being put up for sale, it did not realize the amount of the charges upon it; but the solicitors will take further proceedings when necessary.

In the place of Mr. Macfarlane, the directors appointed Mr. J. Gordon McLaren manager of the company in Klondyke. This gentleman had had considerable experience in Klondyke, and sailed for that country in February last. The position he found on his arrival was a grave one, which gave both him and the directors very great anxiety. The company's properties had been pledged by Mr. Macfarlane with the local bankers to secure £2,500 carrying interest at 2 per cent. per month. This rate of interest, owing to Mr. McLaren's negotiations, was reduced, and by a small personal loan from the directors (since repaid) the properties were protected until gold washing began.

Work was so successfully conducted by the new manager that by the month of July he had paid off the whole loan from the bankers, with interest, and had liquidated all outstanding liabilities.

In August he was able to remit money to England, and at the close of the season in September he had not only paid all expenses of the year in Klondyke and the Government royalties, but he had deposited £3,000 with the bank in Dawson City, and had remitted £4,580 8s. 3d. to London.

YMIR GOLD.

The annual report for the year ending December 31st last discloses a very satisfactory position. During this period 69,505 tons of ore were crushed, yielding a net valve of £1 12s. per ton. The gross proceeds from the ore produced amounted to £114,887, and after allowing for depreciation and mine development, a net profit remained of £45,242. With the balance carried forward from the previous year there was an available profit of £ 86, 201, and of this sum £43,659 has been expended upon machinery, development, etc. Although the policy of the board in the past has been to defray the cost of increased plant, development, etc., out of profits, it is now felt that the company is so well established that it would be to the interest of the shareholders to increase the capital to provide for the cost of further improvements rather than hold back a substantial portion of the profits, and for this object the directors propose to increase the capital of the company by £20,000. The report of the company's engineers speaks very hopefully of the future of the undertaking, and states that at the end of last year there were 134,000 tons of ore in sight, sufficient to keep the stamps in continuous work for over two years. We note that while driving the long tunnel, known as No. 10, until the main body was reached no mineralised rock had been met with, but the manager appears to be quite convinced that the pay chute of the main vein has dipped to the east, and will therefore not be met with until the tunnel has been driven further in that direction. Several economies have been effected, and the cost of stoping has been reduced to 6s. per ton, as compared with about 7s. 9d. during the previous year. The mill returns show that slightly over 2½ tons is crushed per stamp per 24 hours. The cost of milling, excluding the cost of power, is placed at slightly under 2s. a ton. The mill practice is evidently efficient, showing a recovery of nearly 80 per cent. The fall in the price of silver and lead has, of course, affected the company's profits to some extent, amounting to over $28,000 for the year.

KOOTENAY MINING.

The Directors herewith submit the audited statement of accounts of the company from the 1st July, 1900 to the 30th September, 1901, together with the Mine Manager's report and the maps referred to therein.

From a perusal of that report it will be seen that operations have been confined to developing the company's property; the low grade of the ore at present developed and the scale of smelting charges actually ruling not admitting of profitable shipments being made.

One of the Directors visited the mine in October last, and upon his advice Mr. Bernard MacDonald, the Consulting Engineer, was requested to come over to England with a view to discussing the future policy of the Board As a result of this, the Board have decided to continue exploration work towards the west, where the ore shoot in its downward course is expected to be encountered.

During the time which has elapsed since the date when the accounts were made up the amount of £32,357 8s. 7d., standing in the books against sundry debtors, has been reduced by the sum of £15,167 10s. 2d., and satisfactory arrangements have been made with the official receiver of the British America Company for the repayment of the balance. Including this balance, the Directors have an unexpended working capital of over £30,000.

In conclusion, the Directors, after careful and prolonged conversation with Mr. MacDonald, are of the opinion that, although the property is not yet in a remunerative condition, still, having regard to the fact that there is good reason to suppose that the ore shoot disclosed on the upper levels will be found at depth, and also that the cost of reduction will almost certainly be further reduced, there is a fair prospect of your mine before long becoming a payable property.

NOVA SCOTIA GOLD FIELDS.

The following official return of the gold yields from Nova Scotia mines, reported for Royalty, during the past calendar year has been furnished by courtesy of the Department of Mines:—

Name of Company or Operator.	District.	Quartz Crushed.	Yield of Gold.			Period of Crushing.
		Tons.	Oz.	Dwts.	Grs.	
Richardson	Stormont	24,610	3,279	.....	.....	12 Months.
F. A. Sweet	do	590	511	12	.....	9 "
Strathcona	do	4,335	1,775	15	.....	11 "
Griffin	do	129	26	3	.....	1 "
Blue Nose	Sherbrooke	16,134	2,707	.....	.....	12 "
Royal Oak	do	1,235	268	10	3	9 "
New Glasgow	do	22	10	6	.....	1 "
Free Claim	Renfrew	206	349	.....	.....	2 "
Pictou	do	444	1,345	9	.....	7 "
Old Provincial	Wine Harbor	740	80	2	12	4 "
J. S. Lowe	do	3,105	1,153	6	.....	11 "
W. A. Adams	do	110	36	8	.....	3 "
Brookfield	Brookfield	7,515	2,834	4	.....	12 "
Tudor	Waverley	100	31	10	.....	2 "
Waverley	do	12,423	3,013	0	12	12 "
Cyanide	do	1,950	15	16	9	2 "
Cashons	Leipsegate	1,286	604	14	5	12 "
McMann	Hanigan Cove	1,307	617	10	9	11 "
Archibald	do	518	74	16	.....	5 "
H. Sanders	do	2,342	1,903	.....	.....	10 "
Reynolds	Caribou	754	63	4	.....	7 "
Baltimore	do	2,000	610	10	.....	9 "
Moose River	do	1,453	102	7	13	7 "
Touquoy	do	2,815	1,245	2	12	11 "
Dickson	do	15	5	17	.....	1 "
Cyanide	do	5,495	410	.....	.....	4 "
Taylor	Oldham	640	364	2	10	8 "
J. B. Neily	Lake Catcha	55	23	12	15	2 "
J. H. Anderson	do	412	296	17	17	12 "
F. W. Hanright	do	1,388	652	11	16	12 "
M. F. Foster	Blockhouse	465	808	.....	.....	12 "
Nova Scotia	Montague	87	44	5	.....	6 "
Edwards	do	29	13	9	18	3 "
Boyd	do	264	291	19	15	12 "
Madill	Uniacke	770	604	7	.....	7 "
Kenyon	do	175	291	3	.....	6 "
Withrow	do	3	2	.....	.....	1 "
Great Belt	do	788	42	10	.....	2 "
Gold Eagle Mining Co.	Mills Village	642	520	.....	.....	8 "
Worcester	Tangier	536	201	5	.....	3 "
Evans	Malaga	349	320	9	7	12 "
I. W. Horn	Cow Bay	7	12	19	18	1 "
Kemptville	Kemptville	465	209	3	.....	6 "
Brown	do	59	13	18	2	1 "
G. S. Earle	do	2	.....	6	16	1 "
Royal	Whiteburn	123	74	.....	.....	1 "
E. F. Walton	Carleton	101	27	5	.....	3 "
Townsend	Lawrencetown	30	3	3	.....	1 "
A. S. Crooke	do	91	16	19	.....	3 "
Gold Zone	Rawdon	20	11	10	.....	1 "
C. A. Foss	Pleasant River	9	21	10	.....	1 "
Lincoln	Gold River	150	59	9	12	3 "
Crofts Hill	do	100	10	14	.....	2 "
Morland	Various districts	.....	37	12	17	3 "
		99,393	28 049	7	22	

PORT HOOD COAL.

The following is excerpted from the Report of the Directors under date of April last :—The shareholders will be glad to learn that the construction work approaches completion. Every outlay has been well considered and the best advice obtainable has been acted upon at every step.

Some 33 acres of surfaced land has been acquired for bank head and yard purposes ; half a dozen structures bought with the property have proved useful in various ways. During the midsummer season the manager reported that the reservoir built during 1900 ran too low. An unfailing and adequate supply of water has been acquired for present and future needs by the purchase of the bed of the Little River, including 30 feet upon each bank. Foreshore rights have been also secured from the Provincial Government.

The development of the mine has gone steadily on. The actual output of coal has so far been limited by the shipping facilities of the Company. The Manager's report upon this and other subjects is open to inspection.

The first capital issue of the Company has sufficed for all operations to date. If the outlay has been more than originally contemplated, the results obtained furnish the best explanation of the course adopted, the earning power of the Company having been increased to a still higher degree, as a revision of the prospectus would show. Every statement in that document has turned out to be well within the mark.

Still further operations, not originally provided for, are desirable—the carrying of the slope down to about 2000 feet ; an increase in the mine rolling stock ; a further extension of the pier to accommodate larger vessels for an over-sea trade ; the erection of a break-water to the south for the convenience of shipping ; the installation of a washing plant ; a steam tug and several barges ; the construction of miners' houses, for which purposes suitable land has already been secured.

For these purposes, and to replace the working capital which has been diverted to construction work, your directors recommend that you authorize them to issue $250,000 of preferred stock, as a measure in the best interest of the Company.

The quality of the coal shipped has given much satisfaction in each of the eastern provinces, and now that it is possible to ship to other fields equally satisfactory results may be looked for.

NEW VANCOUVER COAL.

Excerpted from recently issued Directors' Report as follows :—The net output for the past half-year was 229,917 tons, making a total for the year 1901 of 494,488 tons, against 501,474 tons for the year 1900.

The sales for the past half-year were 233,033 tons, making a total for the year 1901 of 509,603 tons, against 496,926 tons for the year 1900.

East Field Mine.—The net output during the past half-year from this mine was 109,732 tons, making the total for the year 263,045 tons.

Protection Island Shaft —The net output from the Upper Seam for the past half-year was 59,535 tons, making a total for the year of 119,588 tons, and 1553 tons were obtained, in addition, from the lower seam.

South Field, No. 5 Shaft.—The net output from this mine for the past half-year was 56,203 tons, making a total of 107,408 tons for the year. The whole of this output was from pillars.

Harewood.—The net output from this mine for the past half-year was 2,894 tons, making a total of 8,476 tons for the year.

The strike of coal teamsters, draymen and others, at San Francisco, which commenced at the beginning of August last, and continued for about three months, hindred business and entailed extra cost.

The competition of Fuel Oil is assuming a more serious aspect. Mr. Curtis Thomson, one of your Directors, having to be in the United States at the end of the year kindly acceded to the request of the Board to visit Nanaimo and San Francisco, especially with the view of conferring with Messrs. Rosenfeld, and of studying the position with regard to oil. He visited the Californian Oil Fields, and reports that a very large output from them is to be anticipated, and that the cost of oil at San Francisco is much less than that of its equivalent in coal.

It will be seen from the past half-year's accounts that the profit made amounts to £6,888 15s. 3d. The Directors recommend the payment of a dividend of £3 per cent. free of income tax, making with the interim dividend paid in October last, £6% for the year 1901.

PAYNE CONSOLIDATED.

The following report upon the Payne by Mr, S. F. Parrish, M.E. is excerpted from the Directors' Report issued this month :—In fulfillment of an agreement with Mr. Low, Secretary of your Company, I have visited your property near this place and beg to submit the impressions received upon my first visit.

As you are doubtless aware it is impossible to thoroughly familiarize oneself with an extensively worked mine in a short time, it is to a certain extent a matter of assimilation. However, through the kindness of your Resident Manager, Mr. A. C. Garde, I have been enabled to hasten this process and draw certain conclusions, which I trust will aid you in determining upon future work in the mine.

The first impression received was that the mine had, until within a comparatively short time ago, been worked mainly with the object of extracting as much ore as possible. Its future was apparently ignored, and no attempt was made to prospect below tunnel 5 under the known ore shoot.

Tunnel No. 8 was started in February, 1900, and had to be driven some 1300 odd feet, before it could come under the ore found in the upper tunnels, which meant a year's work at least, probably more, as some of the ground is exceedingly hard. In February 1901, winze No. 1 was started from tunnel No. 5, and in November of the same year an upraise was commenced from tunnel 8 to meet this winze. This was really the first piece of development work below tunnel 5 having in view the deeper exploration of the ore body, which had been stoped out above this level, and from which the great values of the mine were extracted. Tunnel No. 5 did not reveal any special values for a long distance, not really until winze 4 was sunk, and here only a limited extent, beyond this point, however, and to the collar of winze 1, the values increased, and in winze 2 a good showing of galena was made, proving that at least some of the ore found in the upper levels did go below this level.

Mr. Garde's idea in connecting tunnels 5 and 8 was a most excellent one in my opinion, it made easible the exploration of about 375 feet, of ground on the dip of the vein, or vertically 345 feet, at different levels and at a comparatively small cost. This connection will probably be made about the first April. In the meantime a level, No. 6, has been turned from the main



End view of the Milling Plant of the Intercolonial Copper Co., at Dorchester, New Brunswick.

winze, 135 feet below tunnel 5 on the incline of the winze and driven in a southerly direction about 165 feet, it will soon be under winze 2 from tunnel 5, mentioned above as showing the good ore body, when it is proposed to upraise and make a connection. About 75 feet from the main winze ore was found in this level in quantity and of excellent grade and has remained with varying thickness to the present brest. I beleive that it is characteristic of this district that the width of the pay-streak in its veins constantly varies.

The block of ground opened up by this work, about 125 feet by 130 feet will doubtless yield you a large sum of money. In addition to this Mr. Garde has cut a station, 132 feet deeper in the main winze, from which it is proposed to start level 7. Again, tunnel 8, 117 feet further down the winze, will doubtless be driven ahead to intersect the lead.

From the surface cropping on top of the hill on which the Payne and Mountain Chief claims are located to tunnel 8 is a vertical depth of about 900 feet. From the surface to tunnel 4 a depth of 460 feet about all of the shipping ore has been extracted, what little was left is now being broken prior to drawing the filling of concentrating ore, for after that is taken out the walls of the vein will probably come together and this part of the mine will be lost, of which you have boubtless been informed. From tunnel 4 to tunnel 5 a distance of 100 feet, in what is designated on the longitudinal p ojection as block B., very little work has been done, recently an upraise was started to prospect part of this territory, but as yet nothing of value has been found; it is however a large block of almost unexplored ground.

There remains then, the following condition in the mine. It has been opened to a depth of about 900 feet, about 460 feet is practically worked out, excepting the filling as stated above; the next 100 feet has been only partially worked out, and the remaining 340 feet is, with the exception of what has been done on level 6, untouched. In the upper workings of the mine, above tunnel 4, barren and partially barren areas were encountered, and the same condition must be anticipated elsewhere in the mine. Valuable ore has already been found below tunnel 5, and you are justified in my opinion in thoroughly prospectiug the lead on levels 6 and 7 and tunnel 8.

As you are aware the present plant is only large enough to operate one machine drill and the hoisting engine at winze 1. With the improvements contemplated by Mr. Garde, however, this will be remedied in the near future, when I should advise your pushing development work as planned from the 6th. and 7th. levels and tunnel 8, vigourously. In this connection I shall certainly urge the shipment of more ore. This can readily be done now from a block of ground between level 6 and tunnel 5 and north of winze 2. You are now shipping about 100 tons per month and this could be increased to 300 and probably to 400 or 500 tons a month if further prospecting is successful. It may be that with a larger shipment you could secure better smelter rates, in any event your top cost for management and office expenses, foremen and engineers and blacksmiths and top men generally go on the same whether you ship 100 or 500 tons or more a month. There does not seem to be any likelihood of a change in the smelter situation until the refinery now being built at Trail is in operation, when you will probably share in the savings made by this operation. There is no storage room at the mine for any large tonnage of ore, so what is broken in development will have to be shipped. There is, to be sure, some room in the mine for storage, but this means an additional handling and consequently a greater cost.

Familiar as you must be with the present state of the mine, there seems but little for me to say beyond what I have already stated, and that is virtually to carry out the programme laid out by Mr. Garde, in prospecting thoroughly the ground above your lowest level tunnel No. 8 and between tunnels 5 and 4. In doing this conditions may arise which will make it necessary to consider the working of your property at a still greater depth; at present however you have a large area to explore with a fair prospect of finding valuable ore bodies.

There is still too much snow on the ground to see the surface and will be for several months probably, and for this reason I have not seen any adjoining ground. The mill is well on the way towards completion, and considering the exceedingly small investment for such a plant, should pay you well. In conclusion it gives me pleasure to state that all the work accomplished by Mr. Garde, in the mine, which I saw, was thoughtfully planned and well and economically done.

CARIBOO McKINNEY.

The Directors beg to submit to the shareholders their third annual report, and financial statement duly audited, for the year ended 31st December, 1901.

At the beginning of the year, Mr. Geo. B. McAulay, Managing Director, submitted to the Directors the necessity for some extraordinary development of the mine with a view to locating the ore bodies at various points, and as the financial condition of the company did not then warrant the expenditure contemplated, in order to avoid the incurring of indebtedness, Mr. McAulay very generously donated to the company the sum of $30,000 to be expended solely in the special development above referred to.

The operations were carried out as suggested by Mr. McAulay, the result being the locating of a continuous ore body 320 feet in length, of an average width of four feet, on the 3rd and 4th levels west on the Cariboo claim, and also the locating of the vein at a point 45 feet below the 5th level east on the Okanagan claim.

It appearing to your Directors that it would be desi able to have an independent examination and report upon the mine for the information of the shareholders at this meeting, Mr. Harry McMaster, M.E., was, early in December employed for this purpose Mr McMaster spent about 2 weeks in examining the property, and his report will be read to you, and will, I trust, be found satisfactory. It will be noted that Mr. McMaster finds that there is now sufficient ore in sight in the mine to keep the mill running for about two and a half years.

It appears from Mr. McMaster's report, as well as from the report of the Managing Director, that there are still difficulties in the operation of the mine owing to the many faults in the vein at the east end where the highest grade ore has heretofore been found, and that the future of the property at this point depends on getting below these disturbances.

At the last annual meeting of the shareholders it was announced that there would be a suspension of dividends for a period, and while there has been no dividend declared during the last calendar year, your Directors are pleased to state that they have found themselves able to declare a dividend of one and one half per cent. out of the surplus earnings of the property, and leave a reserve sufficient to meet contingencies. While your Directors are unable at the present time to see their way to the resumption of regular dividends, the surplus earnings of the property, after a provision for a proper reserve, will from time to time be divided among the shareholders.

NEW FAIRVIEW CORPORATION.

The following is excerpted from the Report of the Directors' under date of February 5th:—During the past six months over 600 tons of machinery, building material, etc., have been taken down, hauled several miles and erected.

This work has been well done, and reflects great credit on the superintendent. By studying Mr. Ostenburg's report, you will see that the ore we have crushed to the present date is that which was on the dump, and the ore extracted in widening the drifts as the work of timbering and erecting ore shutes was carried on.

The intention is to continue this work until we have the second level filled with shutes to our western boundary, which is about 450 feet from where work is being carried on now. This will take a few months, and in the meantime sufficient ore will be extracted from the widening of the drifts to keep the mill supplied. After this preliminary work, any quantity can be taken as required.

The work of putting in the ore shutes in the first and third levels has been started, but it will be some time before large extraction can be made from the third level, as the present drift to the westward in this level is only 110 feet.

It is gratifying to know that the width of the vein (as well as the values) is greatest in the lowest level.

We are pleased to be able to inform you that the Dominion Consolidated Mines Co., whose property is above the Stemwinder, have made satisfactory arrangements for large working capital, and have already commenced further development.

We are informed by their secretary, that it is their intention to immediately install electric machinery on their water power at Okanagan Falls, transmitting it to Fairview and vicinity. Provided satisfactory arrangements can be made, it is quite probable that all our machinery will be driven by this power, which will effect a considerable saving in operating costs.

Your Directors are of the opinion that the superintendant's recommendations shonld be carried out, and have no doubt but that the improvements suggested can be shortly installed.

The work of the development and prospecting on our coal lands is being carried on in a small way, and sufficient coal is being extracted to meet the local demand.

The call made on the shareholders has been met by nearly 90 per cent. of the whole issued capital.

NEW B.C. DEVELOPMENT CORPORATION.

The following is excerpted from the last Directors' Report received :—Your Directors beg to submit the Report and Accounts for the period from October 2nd, 1900, to October 21st, 1901, as regards British Columbia and from November 23rd, 1900, to December 13th 1901, as regards Leeds.

It will be seen from the accounts that little additional work has been undertaken during the year, the bulk of the Company's capital being invested in the "Emily Edith Mines Limited." The present conditions of carrying on mining in the Slocan are so extremely unfavorable that your Directors would not feel justified in expending further capital on your properties until there is some prospect of a reduction in the prohibitive rates for freight and smelter charges ; to an increase in the market values of silver and lead, and also to an improvement in the labour market and the mining laws in the Province.

Your Directors have offered on easy terms the "Golden Crown" and the "Helena" claims to owners of adjoining properties, and it is hoped that in the spring, when the snow goes, satisfactory developments will encourage the parties interested to take up their options. A working bond was given on the "Silverton Boy" claim (adjoining the "Emily Edith Mine") and a large amount of development work has been done, and although at present suspended the bond may be taken up again next year. Other properties of prospective value have been Crown granted and will therefore only require a trifling expense in holding them for more favourable times. The small amount of disbursements is due to the strict economy exercised by your Board. The salary of the Manager in Vancouver ceased when active development work was discontinued and Mr. Hope most cheerfully agreed to this arrangement. You are, no doubt, aware that this Company holds the principal interest in the "Emily Edith Mines" and your Directors regret that developments have not yet brought any return to the shareholders. A large amount of work has been done on the property under difficult circumstances, and the results are as yet undecided. The "Emily Edith" Company report that the long looked for vein has been cut in the No. 4 tunnel and it is hoped that the ore bodies in the upper levels will also be found to extend to this level. Should this prove to be so the prospects of success will be largely increased and your Directors think that the information desired on this point cannot be long delayed.

IMPERIAL DEVELOPMENT.

The following is taken from the Directors' Report under date 11th, February:—During the year several changes have occurred in the Board. The first was the resignation of Mr. A. L. McCulloch in March, and the appointment of Mr. S. S. Fowler to fill the vacancy. Mr. F. Burnett removed from Nelson and resigned his seat and Mr. McCulloch was reappointed in his place. Later Mr. Fowler and Mr. Kydd withdrew and Mr. J. Laing Stocks and Mr. W. P. Tierney were appointed to fill their places.

The development of our Lardeau properties was steadily prosecuted under Mr. Gracey's supervision, until 1st. June, with results which were most gratifying. During April and May several prospective purchasers opened negotiations with the Board and on June 15th last, a bond confirmed by you in general meeting, was given the London and British Columbia Gold Fields, Limited, on the Eva and Imperial groups. A cash payment was made and they began active development. When the second payment came due they asked for a considerable extension of time, but owing to the position in which we were placed in reference to payments coming due original owners from us, we were unable to grant the full time asked for, and the payment not being made on the extended date given the property reverted to us. Since then we have carried on the development work with results that give us reason for much encouragement as will be seen by reference to the report of our manager.

At the request of the Board, our President, Mr. George Gillies, of Toronto, came to British Columbia in October to consult with us regarding syndicate affairs and visit the property, He expressed himself as being pleased with the progress made and fully in accord with the policy of the Board.

The financial statement explains itself fully. Owing to the heavy payments falling due on the Eva bond during the year (a comparatively small balance only now remaining), we found it necessary to make the six calls on the stock authorized by the articles of association and these have been met with remarkable promptness and unanimity, not a single share having gone by default.

We would recommend that the balance of the shares in the treasury be placed in the hands of the incoming Board.

SUNSHINE LIMITED.

From Directors' Report we extract the following:—The accounts show a profit on the year's working of £284 os. 4d. As the whole of the work done during the past year has been entirely for development purposes, the board have placed the whole of the cost of mining (£2.103 4s. 5d.) to capital. On the other hand, as in the course of development there have been mined about 148 tons of ore, the realized or estimated value of which is credited to the Profit and Loss Account, they have placed to the debit of that account the whole of the charges for management, including the £1,000 per annum paid to the Lillooet Company.

The company still owns the nine claims enumerated in last year's report. The titles to all these claims are Crown granted, except that of the Goldseeker Fractional. The necessary assessment work on this claim has been carried out and the Crown grant should be issued to the company very shortly.

The report of the General Manager in British Columbia is annexed hereto, and gives full particulars of all the work done at the mine during the past year. The original of this report will be laid on the table at the Annual Meeting, as well as the schedules appended to it, showing the details and measurements of the development work.

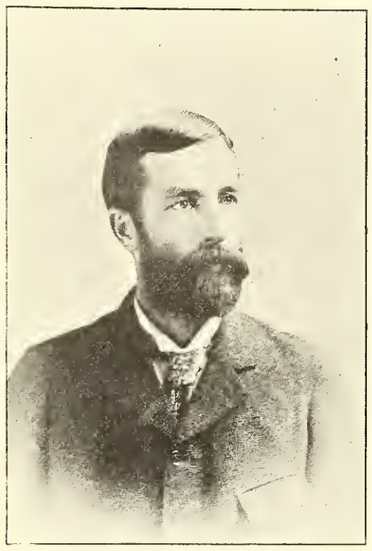
As already stated, the work during the year has been entirely in the nature of development and exploration; and as will be seen from the General Manager's Report, the ore in the mine at and above the 283-ft. level has now been practically blocked out. Should further development have to be carried out at a lower depth, it would be necessary to erect an air compressor to work the drills and pumps.

We have now commenced to stope the ore blocked out during the last two years and it will be sent to the smelter as quickly as practicable. By the last advices from the mine, the General Manager expected to have about 400 tons of first-class ore sacked and ready for shipment by the end of December.

Besides this, there are some 4,500 to 5,000 tons of second-class ore already mined; but to give this any value it would be necessary to go to the expense of erecting a concentrator and tramway. This step your Directors do not at present feel justified in recommending.

GRANBY CONSOLIDATED.

The output now amounting to 1500 tons daily, is to be increased very materially as a result of various contracts just let by the management. When the two additional compressor plants, each with a capacity of 30 drills, are installed a daily production of from 2500 to 3000 tons can be steadily maintained. Jay P. Graves, general manager of the company, in an interview gave an outline of the scope of future operations. "Porter Bros., the railway contractors," said Mr. Graves, "have been awarded the contract for quarrying 100,000 tons of ore from the surface or glory holes of the Granby group, with the understanding that if the work is mutually satisfactory they will be ready to undertake the extraction of 5,000,000 tons of ore. Porter Bros. are to start work within a few days. They will install an extensive plant, comprising derricks and steam shovels. This is not their first experience at that sort of mining, as they formerly extracted ore under similar conditions in the iron mines of Michigan, where the quarrying system prevails to a considerable extent. The ledge across the Granby group has already been partially stripped, but it will be stripped for an additional length of 1500 feet and for a width averaging 200 feet. This, of course, is quite independent of the underground development work directed by the company. It is true that we have let a contract to the Canadian Rand Drill company of Sherbrooke for the building of two compressor electrically driven plants, each with a capacity of 30 drills, the size of the drills being three and one-quarter inches. In order to compensate for the loss of power, owing to the elevation of 5000 feet, the plants will be built 40 per cent larger, thus bringing their efficiency up to that of a similar plant of normal size at sea level. The double plant will probably be the largest of its kind ever built in Canada, and with the present equipment will give us a total of 80 drills. The Cascade Power company has contracted to furnish us with a maximum of 1500 horse power, with a provision to supply us with an extra 500 horse power for proposed enlargements, including two additional furnaces for the smelter at Grand Forks as contemplated. Electrical power will also be supplied by the Phoenix Water and Light company. We are now employing 400 miners at Phoenix and there are 250 names on our smelter payroll. When the new plant is installed we can produce a tonnage of from 2500 to 3000 tons daily.



PROF. WILLET G MILLER,

Who has been appointed Provincial Geologist for the Province of Ontario.

COMPANY NOTES.

Ymir.—Cable from the representative at Nelson:—"During last month 80 stamps ran 701 hours (29 days 5 hours). Estimated profit on operating, $11,268 (£2,344)."

Velvet Rossland.—Cable from manager:—"50½ tons yielded 52 ozs. gold. 69 ozs. silver, 7,826 lbs. copper; gross value $1,979, or an average of $39.19 (£7 16s. 9d) per ton; net proceeds from smelter $1,222, or an average of $24.20 (£4 16s. 10d.) per ton."

Le Roi.—Returns from March:—"24,528 tons of ore were shipped to the Northport smelter, containing 7.522 ozs. of gold, 16,037 ozs. of silver and 358 tons of copper. From value (reckoning copper at 16 cents per pound as in former monthly statements), $274,622, average value $11.19 per ton. Taking Thursday's New York quotations for copper, namely 12¼ cents per lb, reduces the average value to $10.10 per ton."

Molly Gibson.—Shipments for 1902 to May 1 have been as follows:—

1902.	Tons.	Assay Value.	Freight and Treatment.	Net Value.	Average Net Value per ton.
January....	266	$11,392.15	$2,790.80	$8.601.35	$32.34
February...	447	16,232.33	4,184.91	12,047.42	26.99
March	84	3.329.53	815.46	2,514.07	29.93
April	287	10,986.65	2,638.17	8,348.48	29.09
	1,084	$41,940.66	$10,429.34	$31,511.32	$29.07

In addition to the ore shipped as above there are 1,500 tons sacked at the mine, ready for shipment; 225 sacks a day are being mined, so that even though shipments were made on a larger scale there would still be a good surplus which the company intends holding until the silver-lead market improves. Number 4 tunnel is being extended in ore. From Number 5 tunnel a crosscut from the Aspen to the Florence vein will be run, as also a drift east on the Aspen vein.

Slough Creek.—The following cables have been received from the company's mine manager, dated from Barkerville, B.C., the 13th and 21st April:—"Upraise in 37 feet—the vertical depth is 8 feet 6 inches—dry—from the appearance of the face will have very little water—prospects are most encouraging—I certainly think the mine will become a very valuable property." Upraise is in 50 feet—vertical 12 feet—is in good order throughout."

Le Roi.—The secretary of the Le Roi Mining Company, Ltd., has issued the manager's report for March, as follows:—

"For the month ended 31st March the smelter gave the Le Roi mine credit for shipping 24,528 tons 'dry weight,' containing gross values as follows:—

				Per ton.
7,522,529 ozs. Gold at.....	$20.00	=	$150,450	or $6.13
16,037.82 ozs. Silver at.....	.50	=	8,821	or .36
715,716 lbs. Copper at	.12	=	85,886	or 3.50
			$245,157	
Average value per ton.....				$9.99

"Mine Expenditure—The expenditure for the month on mine account was $88,151. The cost of breaking and delivering ore on railroad cars for the month was $2.96, and the cost, including all mine expenditure other than that charged to mine machinery and surface improvements was $3.58.

"Northport Smelter—The expenditure for the month was $227,125. The following statement will give details of ore received at smelter during the month and their contents:—

	Dry tons.	Ozs. Au.	Ozs. Ag.	Lbs. Cu. wet.
Le Roi Mining Company.....	24,529	7,522	16,038	715,716
Public ores	6,235	3,831	9,053	349,453
Total.....	30,764	11,353	25.091	1,065,169

The tonnage treated during the month was as follows:—

	Tons.
Roasted ores.....	24,875
Raw ores, Le Roi.....	148
Raw ores, Le Roi No. 2.....	3,440
Raw ores, R. G. W. Mines.....	404
Concentrates.....	57
Total.....	28,924

Whitewater Mines.—Cable from the company's representative at Nelson, British Columbia:—"During last month 5,500 tons have been milled, producing 482 tons of concentrates. Approximate profit on month's working is $462. Compared to February, mill feed is of lower grade, 15 per cent. The silver has been sold at more than 1 per cent. less per ounce. Number of tons of ore milled decreased 100 tons, owing to want of water. Expenses increased, owing to taxes, $563. Re-timber, $454."

Nimrod Syndicate.—We are informed that a cable has been received from the manager of the Atlin Mining Co., Ltd., a subsidiary of the above syndicate, stating that he expects to begin hydraulicing on or before the 20th May.

Duncan United.—Cablegram from the engineer: "No. 5 level south, Poorman Mine, has been driven 27 ft. since last report by cable. Average assay value, $19 per ton. Shows considerable signs of improvement."

Le Roi No. 2.—The secretary of Le Roi No. 2, Ltd, issued the following to the shareholders on Thursday:—

"In consequence of the circular issued by Le Roi Mining Company on the 13th inst., the following cable was yesterday (14th inst) dispatched to Mr. Bernard Macdonald:—

"'Le Roi Board of Directors have issued hopeless circular to shareholders; Le Roi No. 2 depressed in consequence. Cable what is your opinion as to whether the position of Le Roi No. 2 adversely affected by situation, and, if so, why and to what extent?'

"The following reply has this morning been received:—

"'In reference to your cable dated 14th, any position Le Roi may assume cannot affect the operations Le Roi No. 2. If Northport smelter shut down, Trail smelters are ready for Le Roi No. 2 on the same terms.'

"Office note—The 22 per cent. loss of copper contents mentioned in the Le Roi circular affects only the profits of the Northport smelter, the ore of the Le Roi No. 2 being bought and paid for on a fixed basis before smelting, irrespective of recovery. The last information to hand says that your mine is looking splendid, and your directors wish to emphasize the fact that the collapse of the Le Roi mine has no bearing whatever on Le Roi No. 2."

Mikado (Lake of the Woods District), Ontario.—Cablegram from the mine manager:—"During the period of 52 days ended 3rd May, the mill crushed 2,009 tons of ore, yielding 402 ozs. of gold. During the same period 1,071 tons of tailings were treated by cyanide, and yielded 66 ozs. of bullion. Assay value of tailings, 90 cents."

The Ymir Gold Mines.—A circular has been sent to the shareholders stating that in view of the altered conditions under which the mine is working, as compared with those foreshadowed in Mr. Fowler's report of the 13th February last, the directors consider it advisable that one of their number should at once proceed to British Columbia to investigate the position. Mr. Popkiss has therefore arranged to leave at the end of the present month, accompanied by Mr. Edward Hooper, of Salisbury House, E. C., a mining engineer of wide experience, in whom the directors have the fullest confidence.

Giant.—Mr. D. J. Macdonald cables from Rossland, under date 12th inst., the result of the experimental shipment of 85 tons to the smelter as follows:—"Gross proceeds, $3,250; net profit, $2,750." (Office note—This shipment is from the molybdenum ledge, which carries no copper values, and the returns from the mine will not, in consequence, be affected by the market price of copper. The $2,750 profit, it should be added, is exclusive of molybdenite and cobalt). Referring to Mr. D. J. Macdonald's cable from Rossland of the 12th inst., giving the net profit on a shipment of 85 tons to the smelter as $2,750, a further cable has been received stating that the result of shipment of 50 tons of ore to the smelter from the second-class ore dump is $30 per ton gross.

NEW COMPANIES.

BRITISH COLUMBIA.

Ashnola Coal Company, Limited.—Incorporated 27th March, 1902. Authorized Capital, $1,000,000; in shares of $1.00 each.

Boseco Mines, Limited.—Incorporated 10th March, 1902. Authorized Capital, $10,000; in shares of $1.00 each.

Monarch Gold and Copper Mines, Limited.—Incorporated 2nd April, 1902. Authorized Capital, $300,000; in shares of ten cents each.

Rock Creek Placer Company, Limited.—Incorporated 10th March, 1902. Authorized Capital, $30,000; in shares of $30.00 each.

The Lamderg Mines, Ltd.—Incorporated 1st May, 1902. Authorized capital, $10,000.00, divided into 100,000 shares of 10 cents each. Office: Victoria, B.C.

The Marie Marilla Mining Co. of B.C, Ltd.—Incorporated 1st May, 1902. Authorized capital, $1,600,000.00, divided into 1,600,000 shares of $1 00 each. Office: Victoria, B.C.

Washington Mine, Ltd.—Incorporated 30th April, 1902. Authorized capital, $200,000.00, divided into 200,000 shares of $1.00 each.

The Nanaimo Jubilee Mining and Development Co.—Incorporated 1st May, 1902. Authorized capital, $150,000.00, divided into 150,000 shares of $1.00 each.

The Sapphire Gold Mines, Ltd.—Incorporated 1st May, 1902. Authorized capital $1,500,000, divided into 1,500,000 shares of $1.00 each.

The Diamond Vale Coal and Iron Mines, Ltd.—Incorporated 12th May, 1902. Authorized capital, $1,000,000.00, in 1,000,000 sharas of $1.00 each.

ONTARIO.

Mineral Range Iron Mining Company, Limited.—Incorporated 4th April, 1902. Authorized Capital, $500,000; in shares of $1.00 each. Head Office:—Windsor, Ont.

Globe Refining Co., Ltd.—Incorporated 18th April, 1902. Authorized capital, $300,000, in shares of $100.00 each. Head office: Ottawa, Ont.

Stratford Peat Co., Ltd—Incorporated 27th March, 1902. Authorized capital, $40,000, in shares of $10.00 each. Head office: Toronto, Ont.

The Soo Prospecting and Development Co.—Incorporated 18th April, 1902. Authorized capital, $40,000. Head office: Sault Ste. Marie, Ont.

The Rideau Graphite Company, Ltd.—Incorporated 8th May, 1902. Authorized capital, $30,000 00, in shares of $100.00 each. Head office: Kingston, Ont.

Pickands Iron Company.—Incorporated 8th May, 1902. Authorized capital, $30,000.00. Toronto, Ont.

Chippewa Consolidated Gold Mining and Milling Co., Ltd.—Incorporated 8th May, 1902. Authorized capital, $2,000,000, divided into 2,000,000 shares of $1.00 each. Head office: Toronto, Ont.

Black Rock Mining Co., Ltd.—Incorporated 30th April, 1902. Authorized capital, $150,000.00, divided into 1,500,000 shares of 10 cents each. Head office: London, Ont.

McKellar Island Silver Mining Co.—Incorporated 30th April, 1902. Authorized capital, $10,000. Head office: Noble Alexander Bartlett, Windsor, Ont.

Canadian Oil Fields, Limited.—Registered in London, England, with an authorized capital of £100,000 in 40,000 7½ per cent. cumulative preference shares of £1. There are also 7 per cent. mortgage debentures of £100 to the extent of £15,000. The company, whose head office is at 1 St. Mary Axe, London, E.C., has been formed to acquire as an established, profitable and going concern 561 acres of oil lands, upon which 362 wells are now in full working order and pumping oil daily. In addition to the oil lands in the County of Lambton, the company takes over the business of the Petrolia Crude Oil and Tanking Company, Limited, and the Crown Warehousing Company, Limited, comprising the principal transportation and storage business of the petroleum industry in Canada, with 55 miles of underground pipe lines, collecting stations, pumping engines and other plant. The vendors undertake that the properties acquired and at present being worked are giving a production of 20,000 barrels per annum. It is estimated that the cost of producing crude oil at Petrolia under the amalgamation will not exceed 50 cents per barrel of 35 imperial gallons. The purchase price has been fixed at £56,000, to be satisfied, as to £31,000, in fully paid ordinary shares and as to the balance by the redemption of existing mortgages of £25,000, the vendors receiving no cash.

NOVA SCOTIA.

Copper Crown Mining Co.—This company, owning a smelting plant at Pictou, N.S., has been reorganized. The officers of the company as reconstituted are: President, W. F. Whitney; Vice-President, C. H. Stone; Treasurer, N. E. Martin; Secretary, F. J. Tyler; Local Manager, W. H. Kinnon.

Minudie Coal Mining Co.—The following officers were recently elected President, Max M. Sterne; Manager, Henry McArthur; Secretary, R. S. Hibbard; Directors, James A. Dickey, J. D. McGregor, M. D. Pride, J. H Seaman, John McKeen and C. J. Willis.

INTERCOLONIAL COPPER CO.

Later Details of the Mining and Milling Operations of this New Brunswick Corporation.

Since our remarks on the operations of the Intercolonial Company went to press we have received a copy of a recent report by Prof. Carmichael, of Boston, upon the property, from which we make the following extracts :—

Extending northerly from the village of Dorchester, N.B., is a broad ridge of sandstone which gradually becomes narrower and higher, and finally terminates upon the property of Intercolonial Copper Co., about three miles away. The sandstone is regularly bedded and dips gently to the S.W. Upon the westerly flank of the ridge on the land of the Company and upon the land of the Westmoreland Mining Company outcrop conglomerate and sandstone beds which are impregnated with copper. The copper exists principally in the form of sulphide or chalcocite. In the strata nearest the surface this mineral has in part by the action of the air and moisture been converted into carbonate, which colors the rock green. The chalcocite is associated with the carbonized remains of the carboniferous age to which the rocks containing these fossils belong. The chalcocite containing 79 per cent. of copper, is found occasionally in extended masses, but for the most part, is disseminated as minute grains throughout the working beds. Two distinct levels have been worked and others have been observed. The King lot level is that which outcrops and which has been followed three-quarters of a mile. It has been opened up by several shafts and tunnels

The new main tunnel enters at the base of the ridge above described, and is a most important development of the company's property. It unwaters the mine and allows a considerable stream of water to flow out by gravity which must otherwise be pumped out at great expense. The water from the mine now furnishes an adequate and necessary supply for the mill below. The tunnel, which is 1250 feet long, has directly tapped, as anticipated, the ore bodies, and lateral tunnels have also opened up ore stopes of great extent. One branch of the tunnel extends in the direction of the King lot, and if, later, an uprise is made to the upper workings of the mine, excellent means of ventilating the new slopes will be secured, as well as a more economical route for sending the ore from the upper levels to the mill. For a thickness of about five feet the sand stone conglomerate of the lower level average about about 1.8 per cent. of copper. In many places the ore is much richer, and with some selection, as at the present time, it can be delivered to the mill at 3 per cent copper contents. The development of the mine and the removal of large quantities of copper-bearing rock has shown no diminution in the amount of copper, but has strengthened the opinion constantly held that the amount of ore available is practically inexhaustible. Unlike most copper deposits, this is not a fissure vein formed by chemical action, or eruptive intrusion, but is a part of the original sedimentary formation, and its extension can be depended upon with greater certainty The conditions for economical working are excellent, Labor is plentiful, intelligent, and much less expensive than is generally obtainable in mining districts. The rock is firm, and the workings require practically no timbering. With completion of tramway and power equipment the ore can be run on a level to the mill at a total cost of less than one dollar per ton.

MILLING THE ORE.

The copper is extracted by chemical means. The rock is first crushed in a powerful breaker, aud then passed through reducing rolls and sifted, whereby the whole mass is brought to the predetermined degree of fineness, which at present is about twenty mesh. The ore passes from the screens to large bins, from whence it is automatically fed to the roasters The object of roasting is the removal of sulphur combined with the copper, which would prevent the solution of the latter. At a red heat, in the presence of air, the copper mineral parts with sulphur and is converted into black oxide. The roasters consist of iron tubes of peculiar construction slowly revolving over fires which maintain them at a dull red heat. The roasted ore, as it escapes from the tubes, is received by a conveyor which delivers it to the lixiviation vats. These are circular, 21 feet in diameter, and rest upon massive masonry supports. They are of wood, lined with lead, burned at the joints, and the lead in turn is lined with brick laid in cement to protect the lead from mechanical injury. Upon the bottom of each vat is a filter, and at the centre a covered aperture which is open for the hydraulic discharge of the tailings after the removal of copper. The ore is treated in the vats with a sulphuric acid solution which readily dissolves the oxide of copper. The sulphate of copper solution flows from the vats into a storage tank, where it is impregnated with sulphurous gas. It is proposed to supply this gas without cost from the fumes of one of the roasters, which will be supplied with pyritic ore. The sulphate solution, of a bright blue color, gravitates to the electrolytic cells which are arranged in two series in a terrace. These vats contain lead plates suspended in close proximity, and so connected with the electrical supply that they are alternately positive and negative. Sulphurous gas is also blown through the solution in the cells. The sulphurous acid secures a low voltage, protects the positive plates from oxidation, and produces sulphuric acid necessary for extraction. The copper is deposited in smooth plates of any desired thickness ; it is readily stripped from the lead, and is found to be of extreme purity. The liquor escaping from the cells contains the sulphuric acid liberated from its combination with copper as well as that 'generated from sulphurous acid, and is collected in a tank, from which it is pumped back into extracting vats for the treatment of successive lots of ore. The acid liquor is thus kept in continuous circulation. Theoretically the stock of sulphuric acid is doubled for each cycle, but practically the excess of acid is consumed in neutralizing the ore. The electricity is supplied from dynamos driven by a special engine.

The leaching and electrolytic departments of the mill, at present of less capacity that the crusher, rolls and roasters, can readily be extended at any time, so that a uniform production of copper can be maintained.

THE LE ROI POSITION.

Heavy Smelter Losses.—The Liabilities Exceed the Net Assets

The directors of Le Roi Mining Company have issued the following circular to the shareholders under date the 13th inst :—

"On 28th April we published the following statement ;—

"In consideration of the fact that 24,528 tons of ore mined during the month of March were estimated to yield a profit of only $9,950, the directors cabled to Mr. Mackenzie, asking whether it would not be politic to conserve the ore reserves, pending a reduction of working expenses, and his reply (dated 27th April) has been received today (28th April) :—

"Mr. Mackenzie says that with copper and silver at present prices, and fuel and freight at present prices, the March grade of ore leaves no profit, and he has already begun to sort the ore more closely, making April grade up to $10 50 per ton. He also reports that he is experiencing difficulty with smelting operations, and has reason to believe a considerable percentage of the copper contents are not being recovered. He is, therefore, going to clean up at the smelter to ascertain to what extent this is so If the clean-up shows losses which the difference between assay values and recovery indicate, Mr. Mackenzie strongly advises treating the ore on hand at the smelter, and then to shut down smelting works entirely until we can obtain satisfactory freight and fuel rates and prices have risen for metals, to push ahead with developments in the lower levels, work being done by contract, and reduce expenses to the lowest possible point.

"'Mr. Mackenzie further informs us that he has written fully on this subject, and advises delaying any action pending the receipt of his letter and the result of the clean-up at the smelter.'

"The correspondence here mentioned has come to hand, and includes a report made by the smelter manager.

"Mr. Mackenzie has also cabled the result of the clean-up at Northport, which shows the losses in smelting to be 22 per cent. of the copper contents, and 2 per cent of the silver contents of the ores treated.

"Since 30th November, the value of the metals not recovered amounts to $108,000. Mr. Mackenzie, in estimating profits, has apparently made no allowance for these losses ; in reality, therefore, no profits have been made.

"The smelter manager reports that the extraction cannot be improved, and that it is quite as good as any obtained by other smelting works treating ore of simular grade and character. He also states plainly that to smelt Le Roi ore (of the present grade) alone, with present prices of copper and coke, will leave a very small profit, if any.

"Mr. Mackenzie, in his last monthly statement of the financial position of the company, gives assets in excess of bank indebtedness at 31st March to be $63,000 (approximately). He now informs us by cable that at 30th April the total liabilities exceed the net assets by $200,000, because, in addition to the $108,000 already mentioned as the value of the metals not recovered, the clean-up shows a reduction in the value of the stock in hand of $275,500.

"The situation is therefore a very serious one. The directors are in cable communication with the manager with a view to making the most satisfactory arrangements for the immediate future ; at the same time they feel the only course open to them is to call the shareholders together, and this will be done as soon as possible."

MISCELLANEOUS.

Sawdust Fuel Briquettes.

Sawdust in cake form appears to have been used as fuel in Germany with rather promising results. "Cassier's Magazine" for April, quoting from a report of the United States Consul at Berne, says that the sawdust cakes are octagon shaped, 6½in. long, 3½in. wide, and three-quarters of an inch thick, weighing about half a pound each. In the district surrounding the factory where these cakes were made the schools were heated by them, the combustion leaving very little ash and proceeding without a large flame. No binding ingredient is said to be used, the sawdust being simply dried and pressed into the desired briquette shape, and owing thus to the absence of tarry or oily substances there is no smoke in burning. The weight of such a briquette indicates the heavy pressure under which it takes its shape, and the edges look like polished oak ; in fact, it is heavier than a piece of hardwood of the same size. The demand created by the popularity of the fuel exceeded the supply of sawdust obtainable in the vicinity of the factory, and shiploads were, therefore, procured from Sweden and carloads from distant manufactories. Sawdust, which previously could be had for the asking demanded a market price as soon as it became known that a certain factory could make use of it. Even then it was profitable to manufacture the briquettes ; but, unfortunately, the factory was destroyed by fire and operations came to a standstill. Making sawdust briquettes of this kind would, therefore, seem to be worth inquiring into further.

Belting : Its Use and Abuse.

That is the title of a paper read by Mr. W. H. McBarnes at a meeting of the Ohio Society of Mechanical Engineers. He contended that much better service would be obtained from belts if users would pay a fair price, but if they will insist on low-priced belts they must expect to get a quality accordingly. Again, belts wear out quickly because they do not get proper care. To let a belt run one moment after it gets too slack is bad practice, for it is apt to slip and burn all the staying qualities out of it. Another good reason why it should not be run slack is that the engineer or belt man, to save work, would be tempted to put on a dressing, or, worse yet, put on resin to make it pull, and, in the language of Rex, "the man who will put

resin on his belts is either a fool or a knave," for it is sure to spoil his belt if continued for any length of time.

In an emergency, as when some unforeseen substance has found its way to the belt, it may be necessary, to keep from shutting down between hours, to use some of the so-called dressing. We know from experience that engineers will go to almost any extreme to get out of a tight place—circumstances sometimes making it necessary to keep a belt running when it should not—but this should not be allowed to any extent. To allow a belt to run too tight is just as bad, for it will make short life for the belt, hot boxes, and scored shafting. There is not one in 20 who takes the time or can splice a belt properly; it is generally done in a hurry any way to make it hold together. How often we see boards nailed up or rims tacked on to keep belts from getting off the pulleys. All this is good for the belt dealers.

Peat Fuel in Scandinavia.

The present high prices of coal are stimulating effort in Norway in the matter of utilising the extensive peat bogs of that country. In a paper read before the Institution of Civil Engineers, Mr. Alfred Bache points out the difficulties to be contended with. The crude peat contains so large an amount of water, and even when dried it is so bulky in proportion to its heating value. The latter objection is met by compressing the dried peat into briquettes, which, though forming a useful fuel, is said to smell unpleasantly, unless burnt in fireplaces specially designed. A more thorough plan is to coke the dried peat, thereby obtaining an ideal fuel, in which is concentrated the greatest possible heating value.

In the opinion of Mr. Adolf Dal, who is a State Peat Master, the present dearth of coal will prove a great boon to Norway if it stimulates the growth of the peat industry. It is not advisable now, he considers, to await the complete solution of the problem of coaling peat in such a way as to obtain the best product with the greatest economy, but advantage should be taken of the present favourable opportunity for utilising peat as commonly manufactured by machinery, short of coaling. The crude peat is kneaded in machines of various kinds, either direct from the bog or with added water; the fibres are ground asunder, squeezed together, and the less rotted portions are torn apart and mixed with the fully-rotted portions. Hence, when it dries the ground peat becomes much more solid and dense than that which is dried in lumps as dug from the bog; it is also more convenient for transport. Such peat made in Norwegian factories was found by Mr. Dal to have a specific gravity ranging between 0·6 and 1·1, most commonly 0 8 to 0 9; and to contain 1·96 to 8·8 per cent. of ash, generally 3½ to 5½ per cent., reckoning the perceutage on thoroughly dry peat. The quality naturally varies, according as the crude material itself varies between light mossy peat but little rotted, and black rich peat. It undergoes no chemical change in the kneading machines, so that its heating power is equal to that of the crude material, and is commonly taken at 3,500 calories per kilogramme (6,300 British thermal units per lb.) The peat so manufactured is useful for most firing for which coal is now used; it gets up steam and keeps it up as well as does coal; it burns up completely, leaving no clinker, and makes less smoke than coal, as it contains less carbon. Containing less sulphur, it attacks boilers less, as established by experiments.

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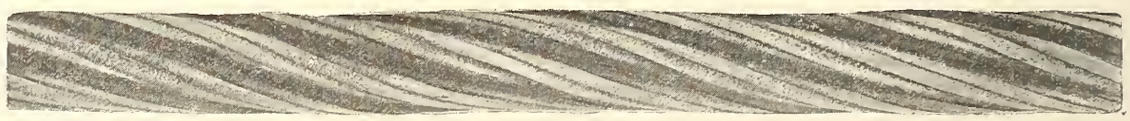


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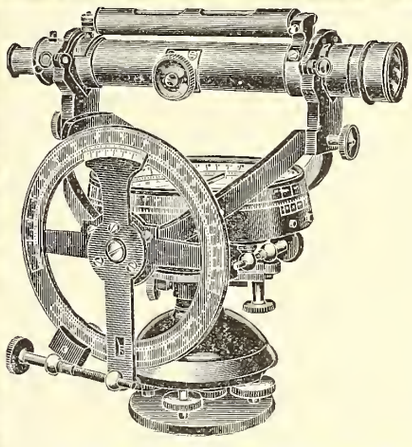
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for the purpose of completing the Eastern Ontario Section of the Institute. A programme of papers will be presented.

B. T. A. BELL, *General Secretary.* CHARLES FERGIE, *President.* W. L. GOODWIN, *Chairman.*

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EASTERN TOWNSHIPS SECTION.

A PUBLIC MEETING of Mine Owners, Managers and Mining Engineers, and others interested in the mining industries of the Eastern Townships of Quebec, will be held in the Board of Trade, **SHERBROOKE, QUE.**, on

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AT 3 P.M. AND 8 P.M.

for the purpose of completing the organization of the Eastern Townships Section of the Institute. A programme of papers will be submitted for discussion. All mining men cordially invited.

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NOVA SCOTIA SECTION.

A PUBLIC MEETING of Mine Owners and Mine Managers, Mining, Civil and Mechanical Engineers, and all who may be interested in promoting the welfare of the profession and industry of mining in the Province of Nova Scotia, will be held **AT SYDNEY, CAPE BRETON**, on

Friday Evening, 13th June, 1902

for the purpose of completing the organization of the Nova Scotia Section of the Institute.

A programme of papers on subjects of interest to the coal, iron and gold mining members will be presented.

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BRITISH COLUMBIA SECTION.

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Tuesday, 9th September, 1902

(AFTERNOON AND EVENING SESSIONS)

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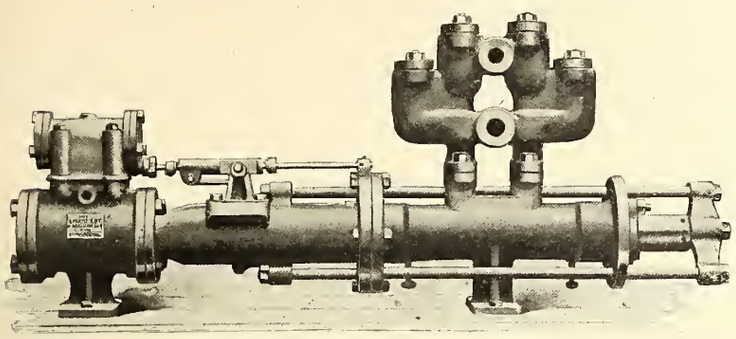
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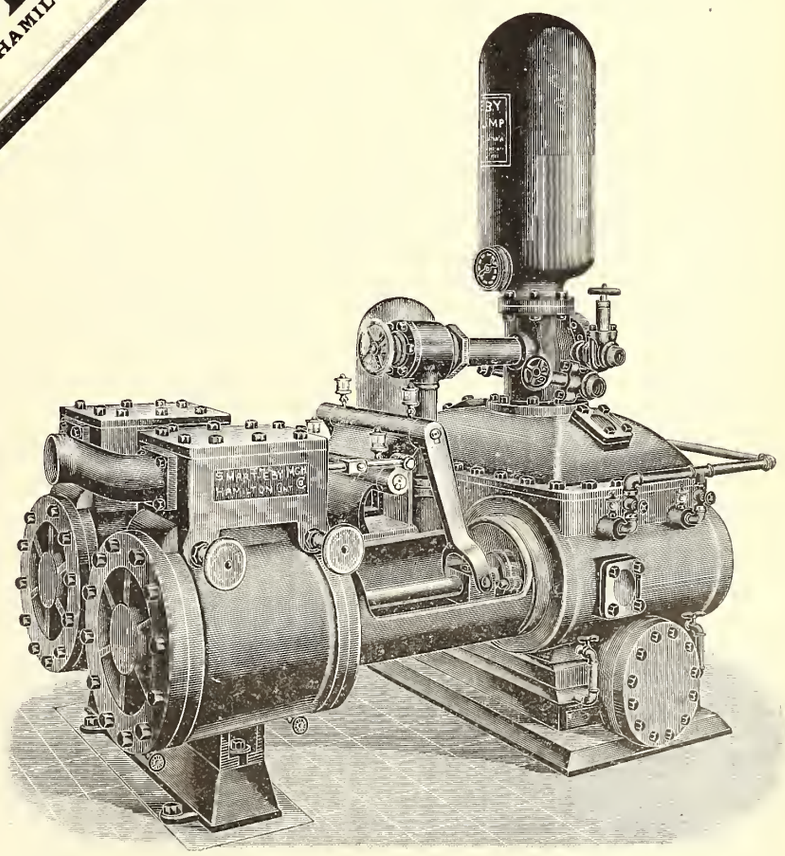


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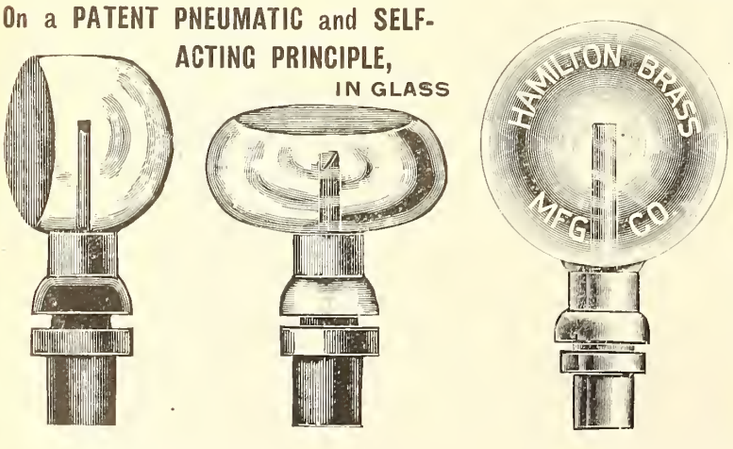
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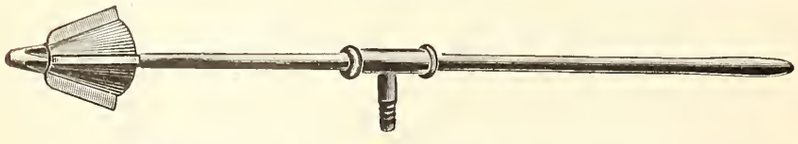
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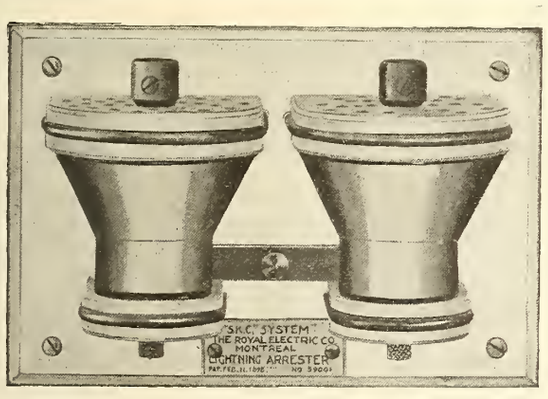
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THE

Canadian Pacific Railway

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OF

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DAILY
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YEAR.

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the IMPERIAL LIMITED trains, crossing the continent in 97 hours, will leave Montreal and Toronto for Vancouver every Sunday, Wednesday and Friday, June to October.

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PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents anuually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

PROVINCE of QUEBEC

The attention of Miners and Capitalists in the United States and in Europe is invited to the

GREAT MINERAL TERRITORY

Open for investment in the Province of Quebec.

Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at the mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order in Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's Certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end on the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 an acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee $5.00 renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed in the river below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent. on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River and Hill Claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer Claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim, and each person in his or its employment, except house servants, must hold a Free Miner's Certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of five per cent charged on the gross output of the claim, with the exception of an annual exemption of $5,000 00.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek or gulch, but the same miner may hold any number of claims by purchase, and Free Miners, not exceeding ten in number, may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch or river, by giving notice and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00 and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette.*

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, and a royalty of five per cent. on the gross output, less an annual exemption of $25,000.00 are charged. Operations must be commenced within one year from the date of the lease, and not less than $5,000 must be expended annually. The lease excludes all base metals, quartz and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite : copper in sulphide and native form ; gold, mostly in free milling quartz ; silver, native and sulphides ; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

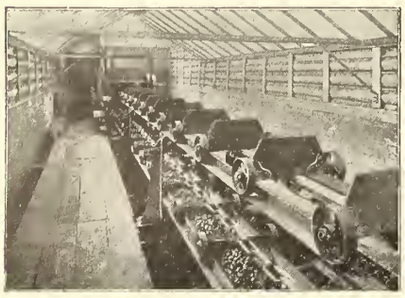
For reports of the Bureau of Mines, maps, mining laws, etc , apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

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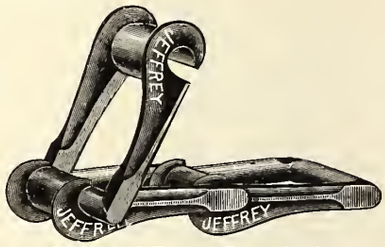
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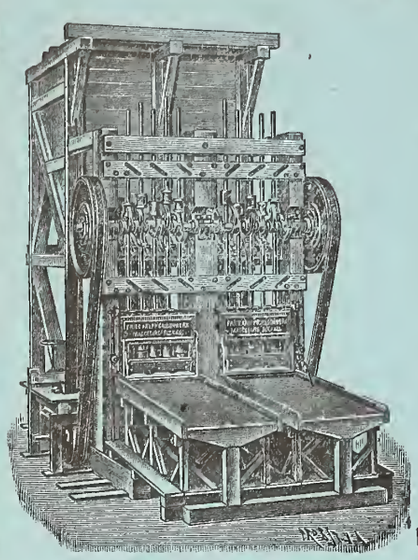
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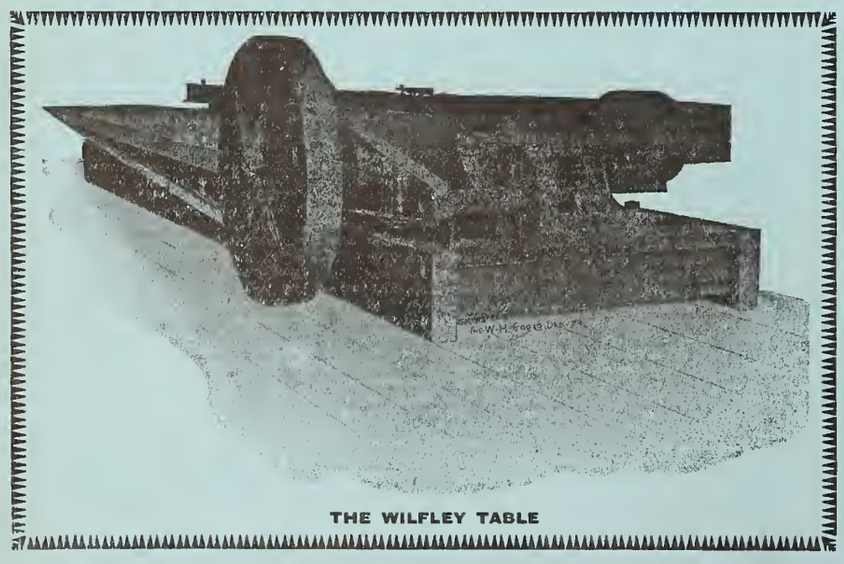
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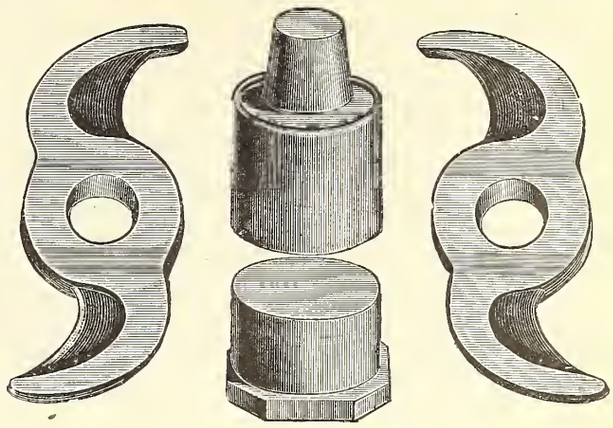
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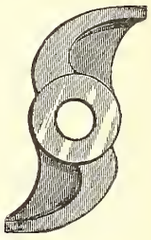
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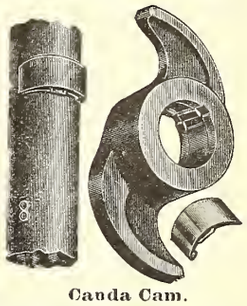
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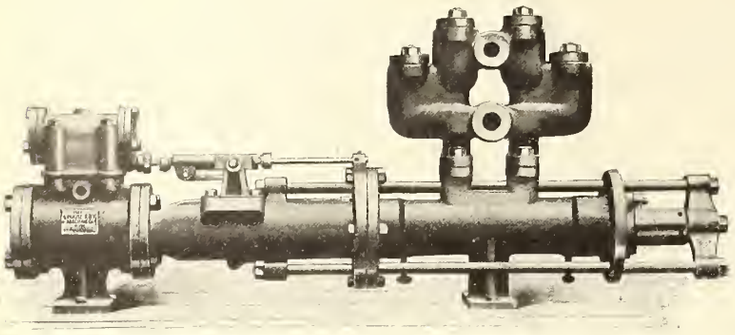
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THE accompanying cuts show an Underwriters Fire Pump and one of our Single Cylinder Outside Packed Pumps with Pot Valves.

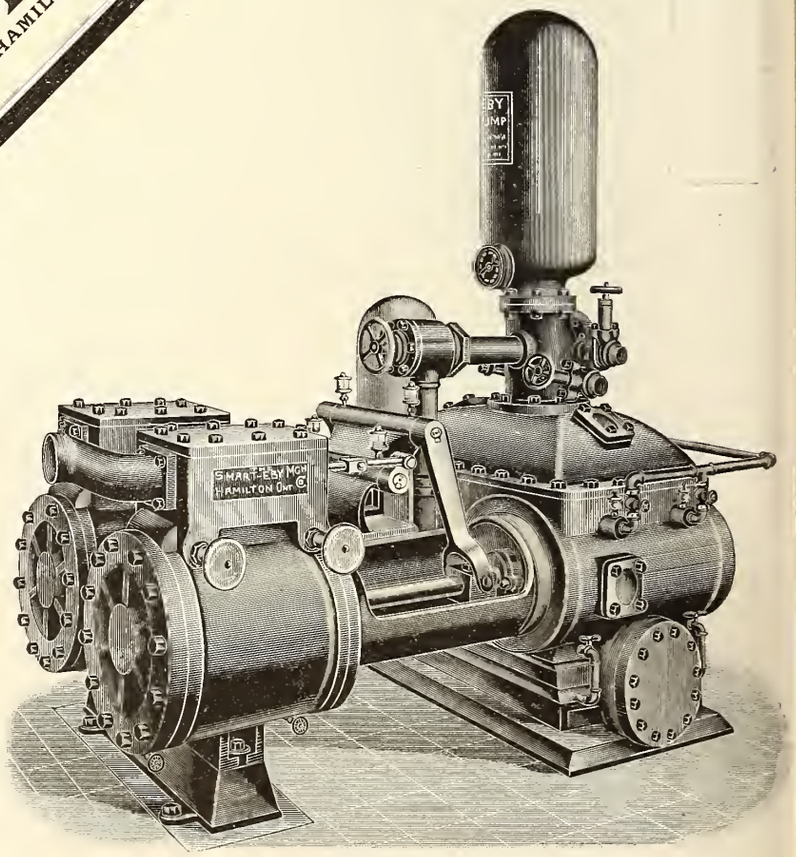
The Fire Pump is built in strict accordance with Mr. John R. Freeman's specifications, and consequently requires no further description.

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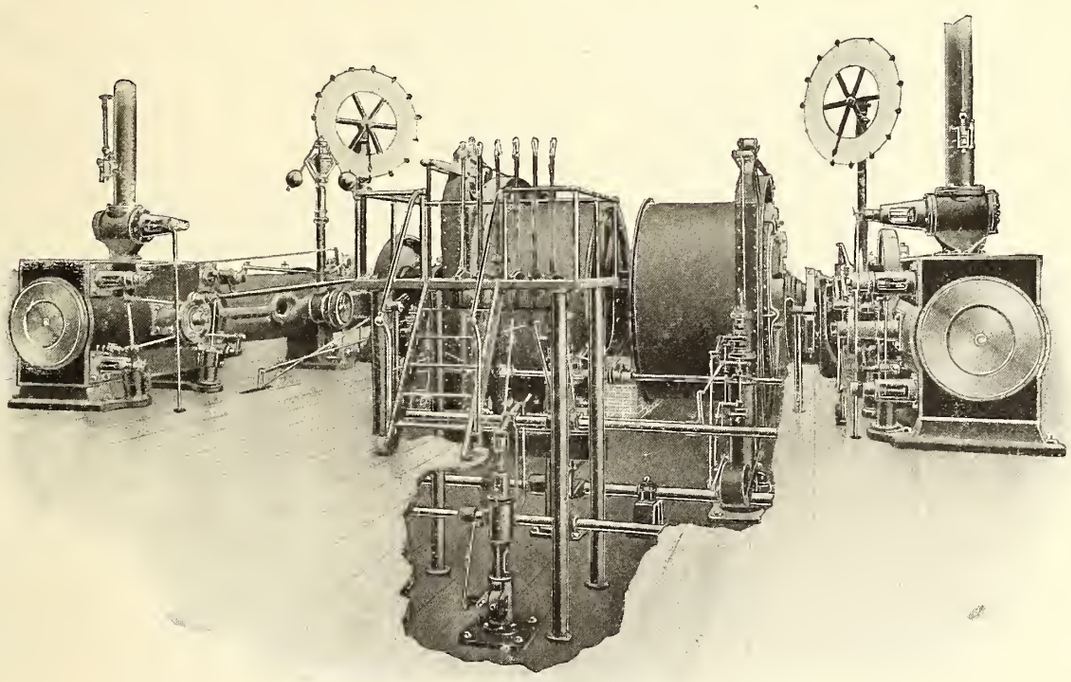
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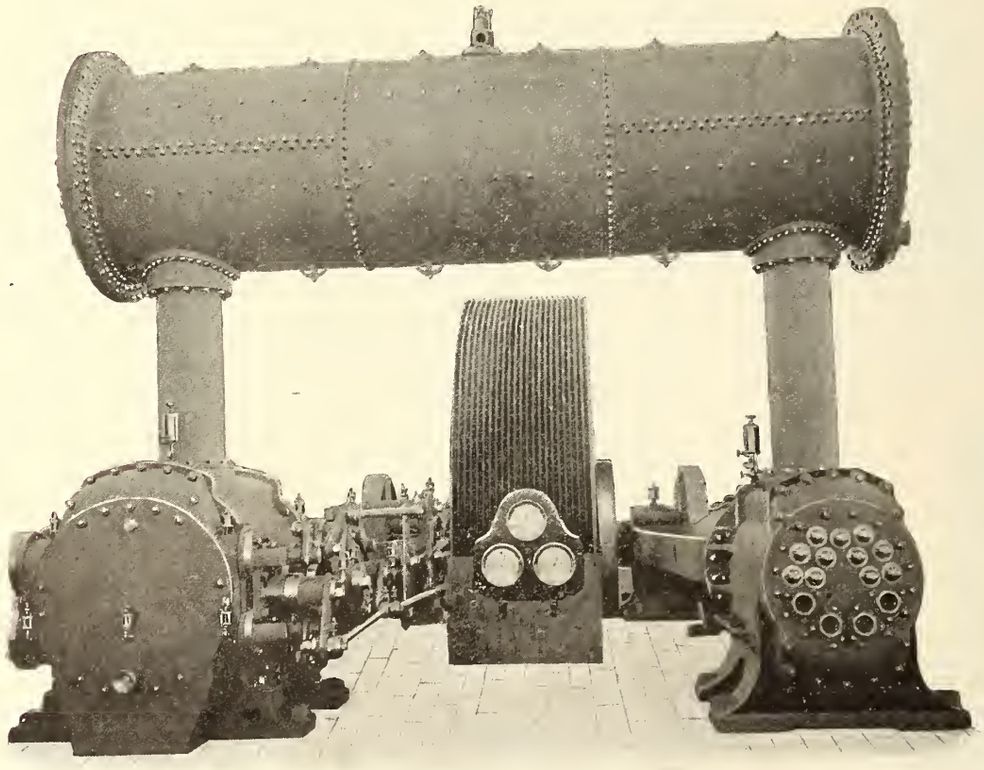
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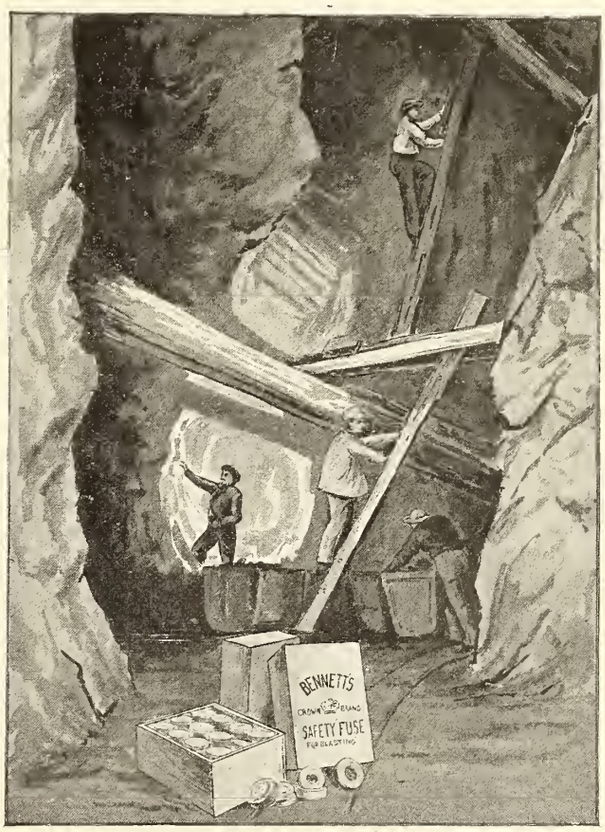
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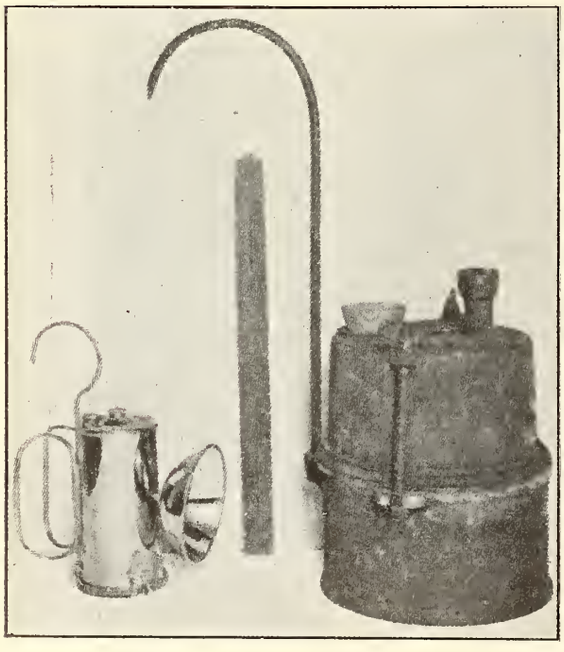
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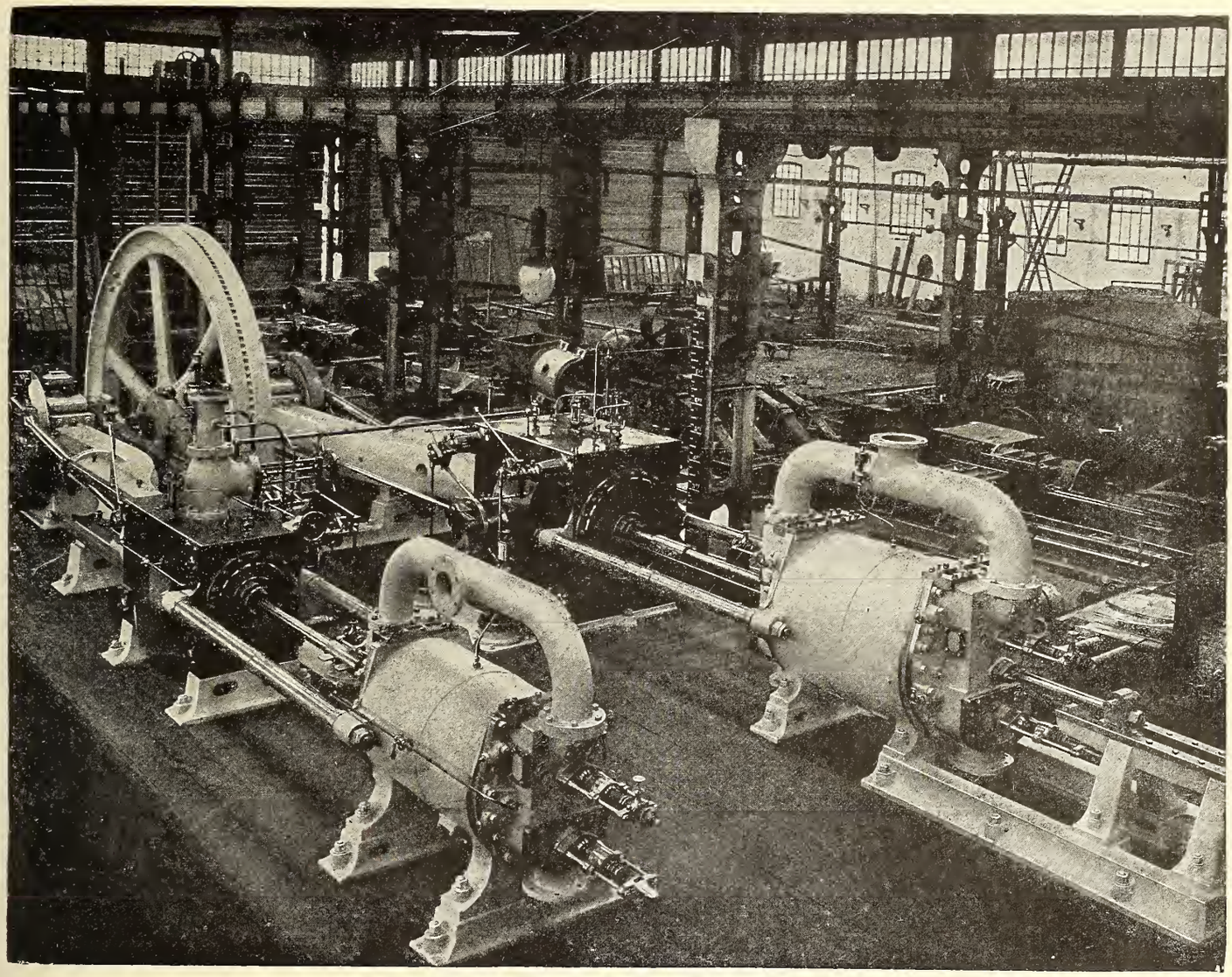
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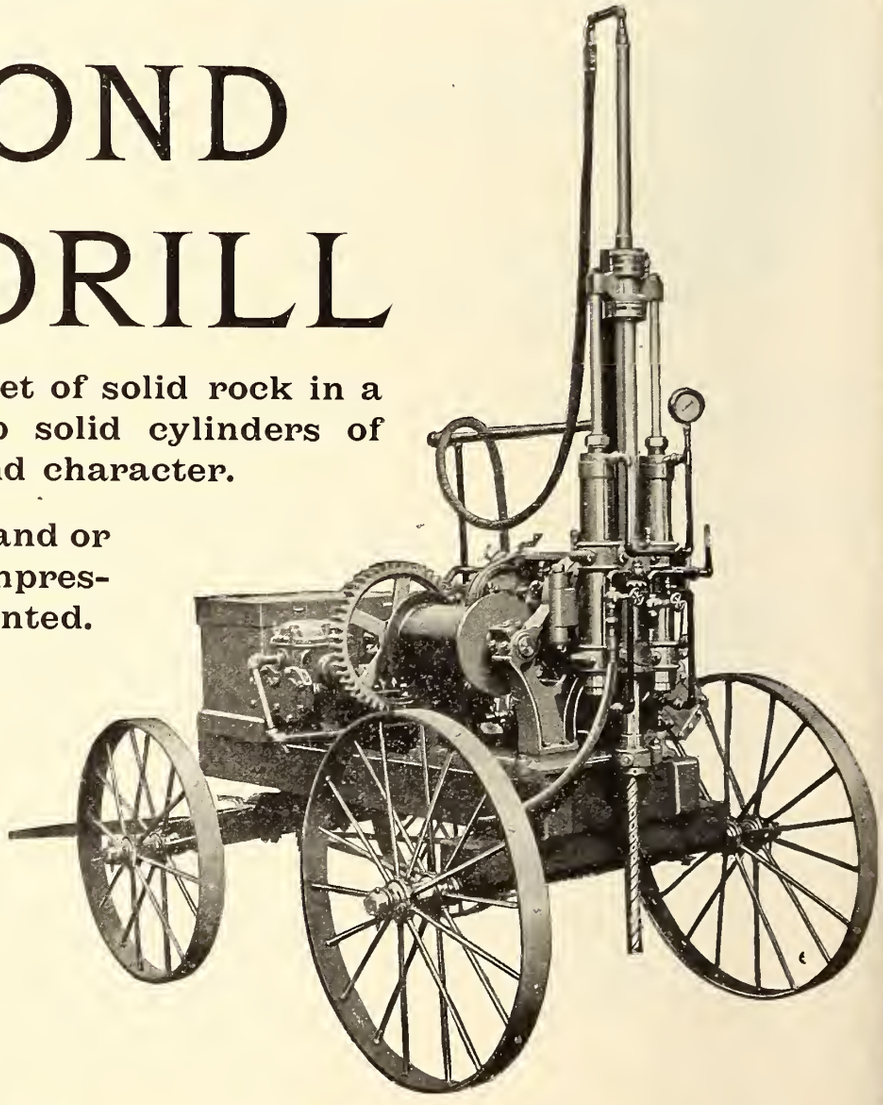
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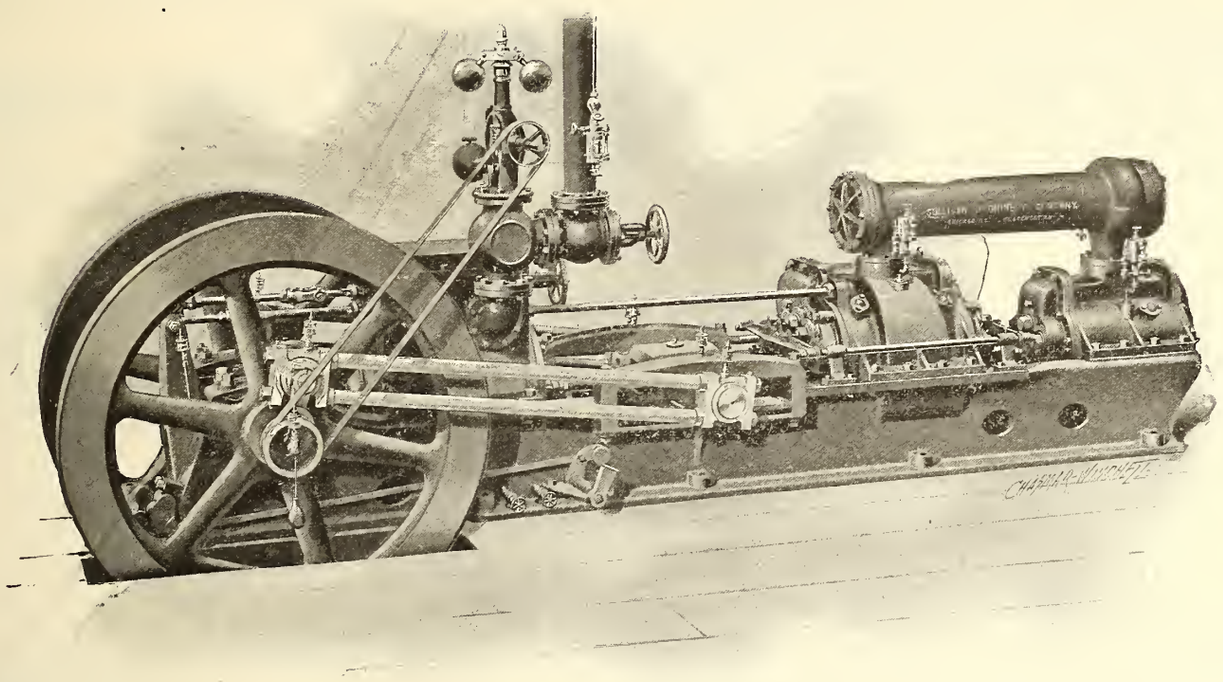
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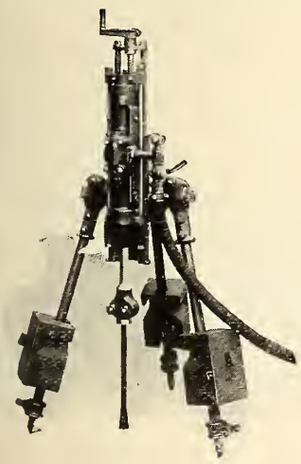
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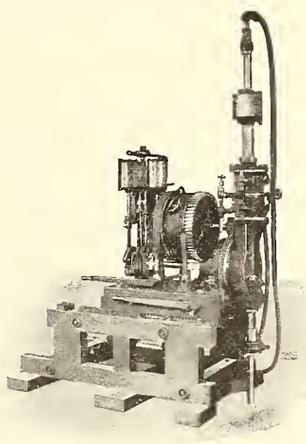


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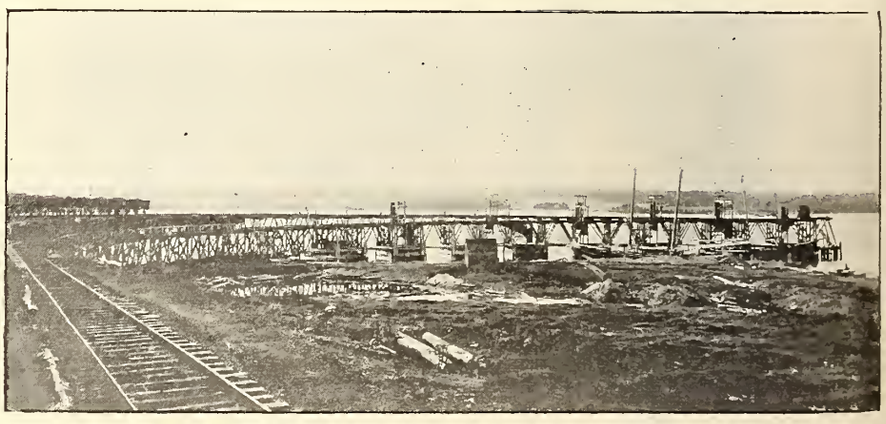
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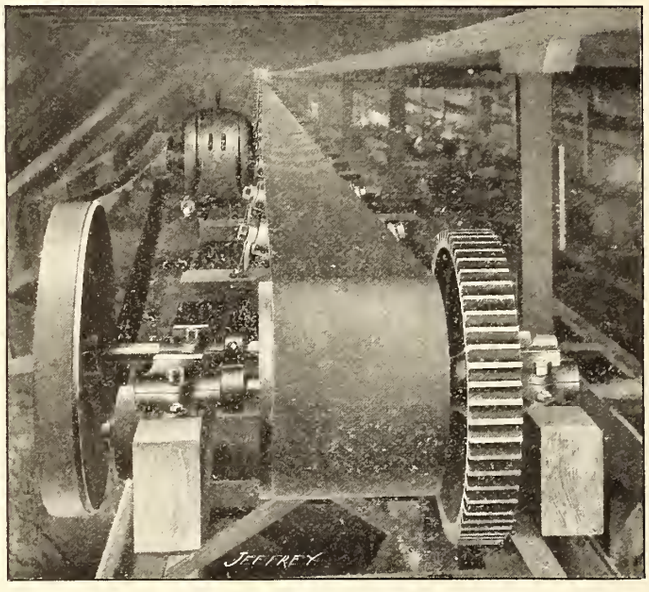
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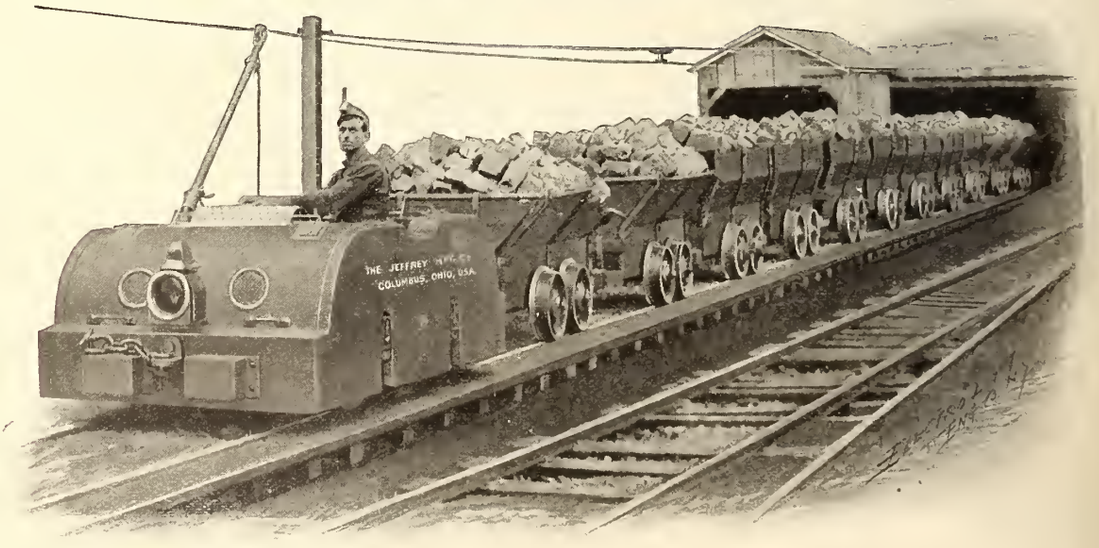
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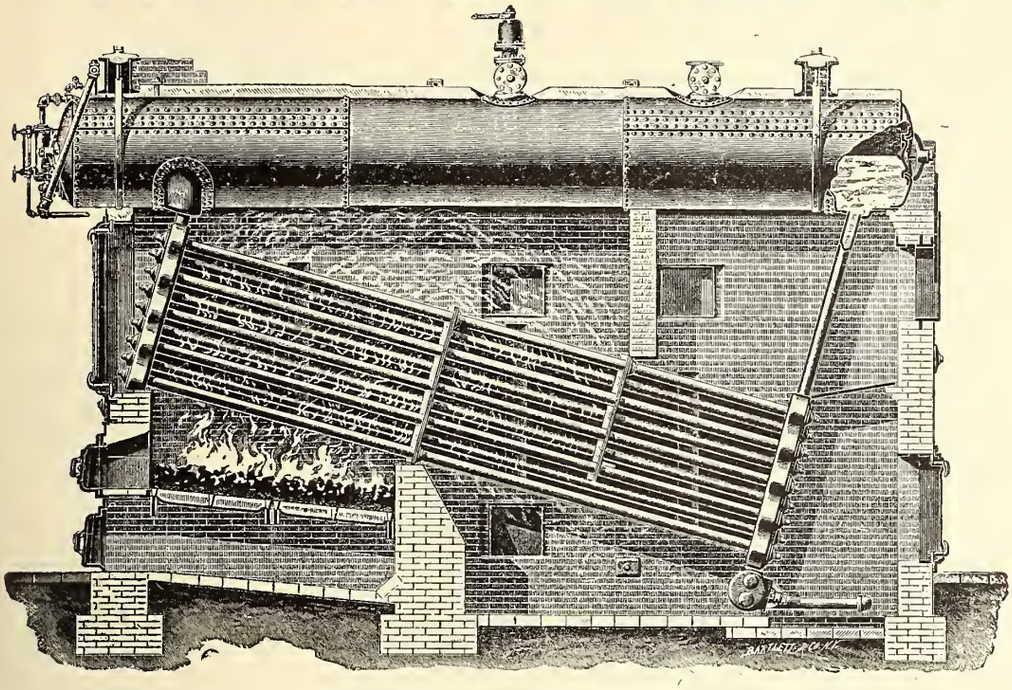
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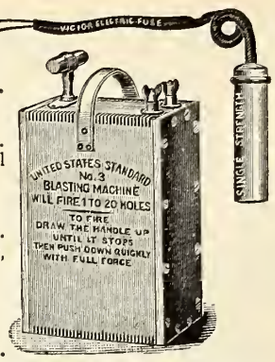
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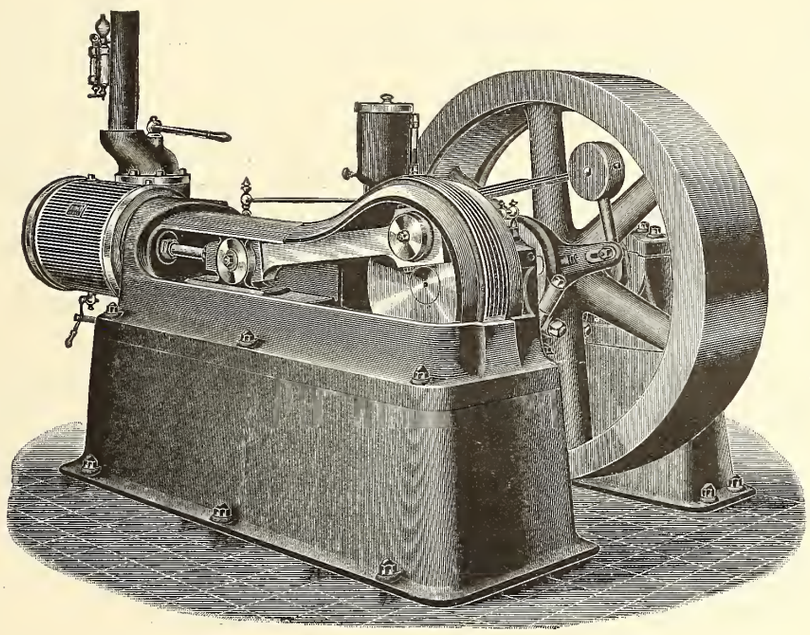
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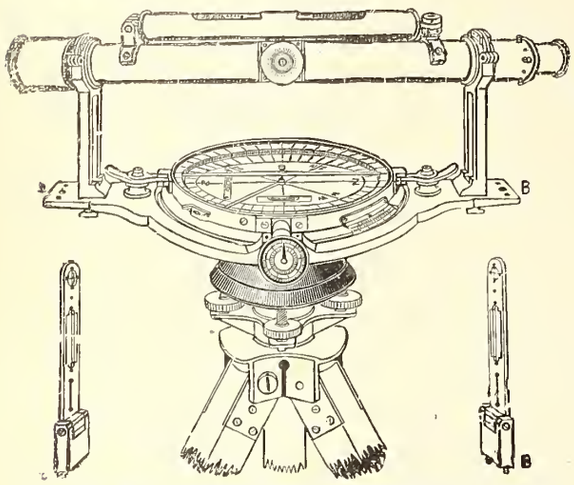
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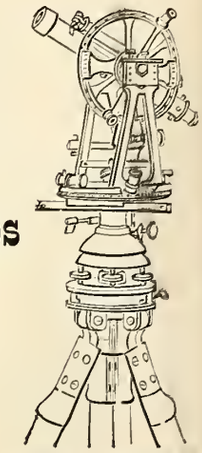
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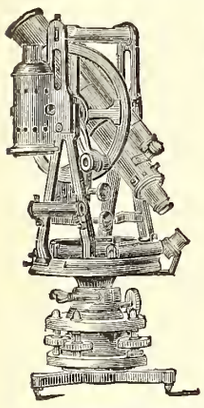
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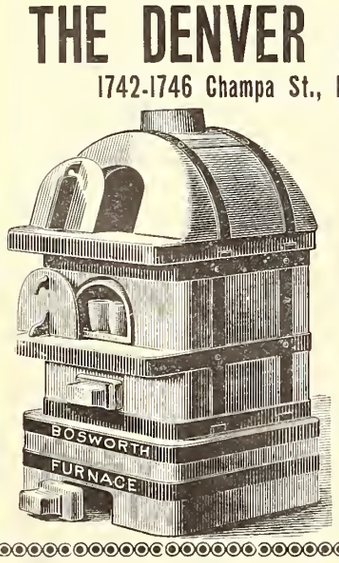
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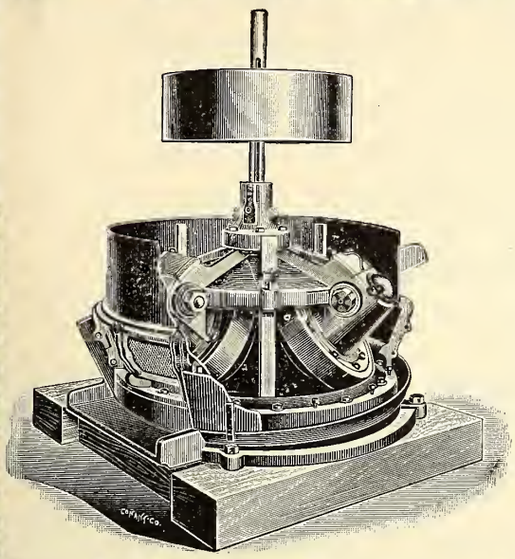
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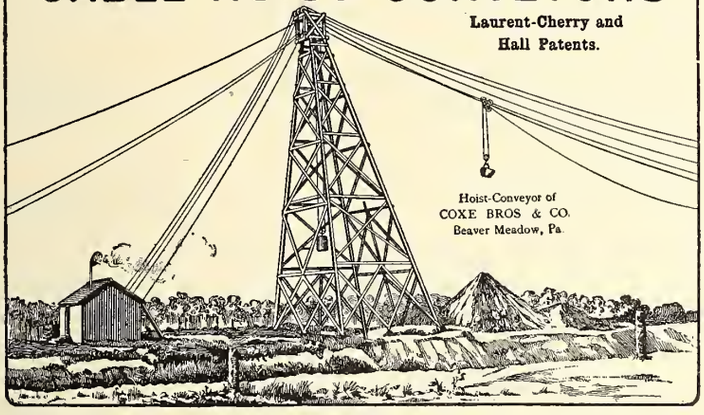
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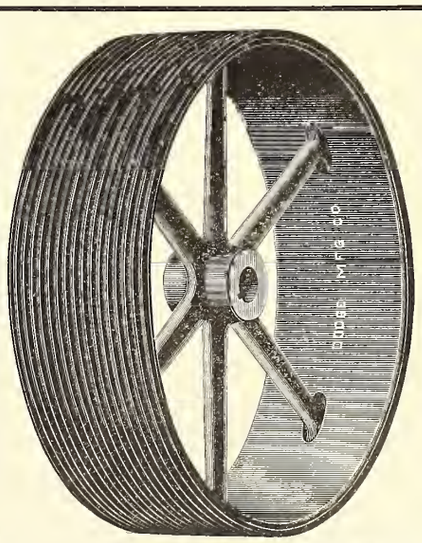
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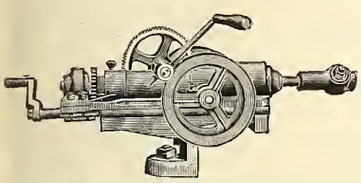
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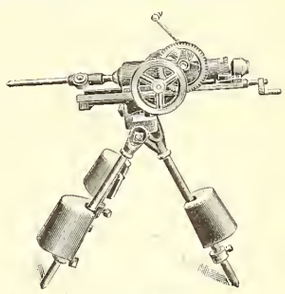
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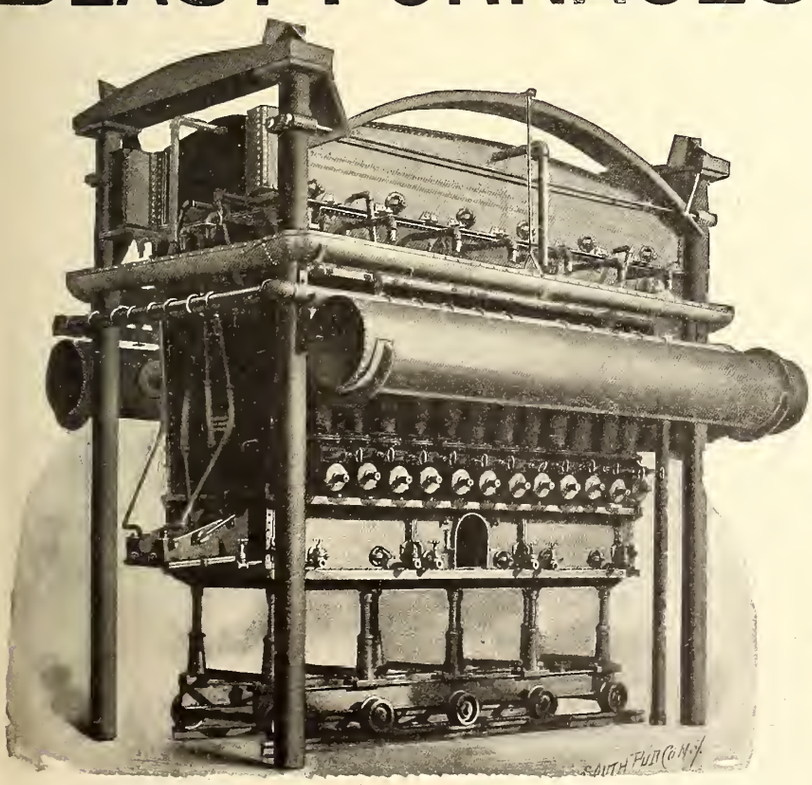
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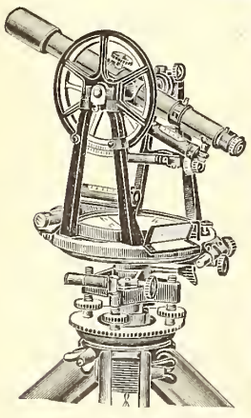
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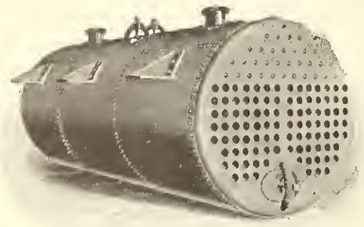
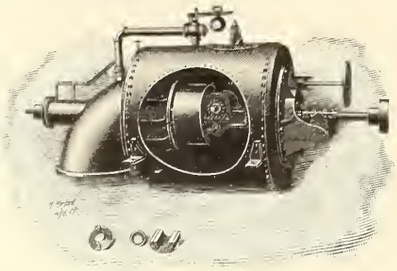
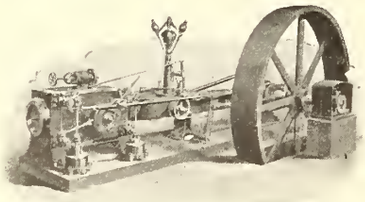
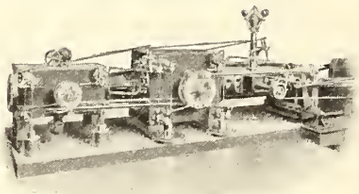
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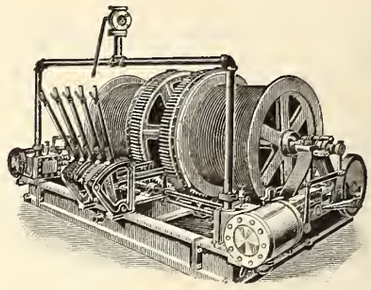
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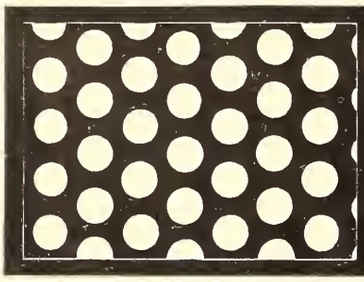
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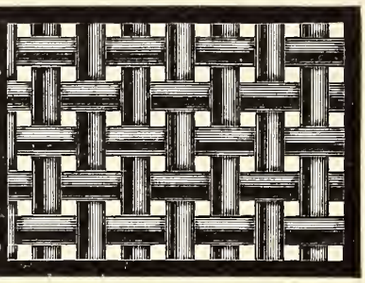


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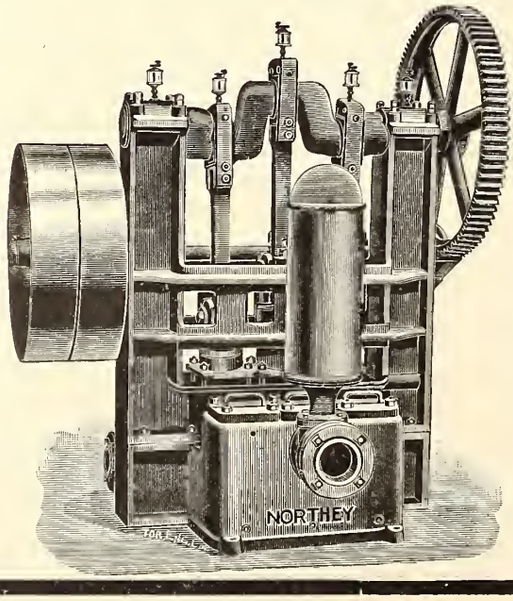
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VOL. XXI., No. 6. JUNE, 1902. VOL. XXI., No. 6.

The Fernie Explosion.

On May 22nd an explosion occurred in the Fernie mines of the Crow's Nest Pass Coal Co., by which 130 men lost their lives. An inquest on the bodies, which owing to the presence of expert witnesses sent by the Government, took the form of an investigation, lasting for twelve days, was concluded on the 21st instant, and a verdict unanimously arrived at of which the full text is given below. The purport is that the widespread explosion resulted from the presence of a large quantity of dry coal dust which had been allowed to accumulate in the mine until it became dangerous, and the jury added to their verdict recommendations to the Government to enforce the use of a better safety lamp, additional precautions as to blasting, a more thorough inspection of old workings, and an efficient system of watering.

This forms a strong indictment against the management, which, on the evidence adduced, was either ignorant of the true character of the danger existing in the mine, or of the precautions necessary to be taken for the protection of the miners, to say nothing of the property. The facts briefly are that the mine in question, No. 2, is situated on Coal creek, five miles from the town of Fernie, employing about 400 men and having an output of nearly 1,000 tons a day. It works three shifts, two for coal-getting and one for repairs. The morning shift had safely finished work on the 22nd May and the afternoon shift, commencing at 3 o'clock, had continued until 7.30, when a tremendous blast came from the tunnel mouth of No. 2 and No. 3 mines, which are only 100 feet apart, sending out clouds of dust and debris, flinging timbers and coal across the creek, smashing the sides and roof of the surface store-rooms and blowing the roof off the fan-house. In addition, a column of dust, like the spouting of a crater, rushed from the fan-house into the air to the height of 500 feet. There was no smoke and no flame. There were at this time in the two mines, which were connected, 152 men. The fan was saved by the blowing away of the roof, and, being unaffected, continued to revolve. Within a few minutes eager rescuers began to enter No. 3 tunnel and were able to assist 22 men, already in the last throes of a death struggle with after-damp, to escape. These are all who were saved, for almost immediately the whole of the workings to the mouth of each tunnel were filled with after-damp and it was certain that every man in the mine was dead. From the 22nd May to date rescue work was continued. Only three or four bodies are still missing, and they, it is almost certain, lie buried beneath falls of rock in some of the roads. There are 50 widows and 60 families bereft by this, one of the most extensive and fatal mine explosions with which we have had to deal in Canada. As the whole of the evidence will shortly be available we do not propose to discuss it at any length in this article, reserving a detailed examination for our next issue, but the magnitude of the disaster and the many important points raised during the investigation demand a passing comment, especially in view of the gravity of the verdict returned by the jury.

First of all, the fact is finally conceded by all parties that it was a coal-dust explosion. Every effort was made by the company to combat this theory, which was laid down a few days after the explosion by Mr. Wm. Blakemore, a former manager of the mine, in an expert report, but in the end the company's managers, the miners' committee and the Government experts confirmed the accuracy of his deductions, and the jury endorsed it in their findings. This is an important matter, because it establishes for the first time in Canada what has long been admitted in Great Britain, and raises the hope that such an admission will lead to the adoption of the most modern and scientific methods of dealing with what Professor Galloway, the greatest living authority on coal-dust, in his latest report on the Universal Colliery explosion in Glamorgan, says is "the *greatest* danger" in coal mines.

The Crow's Nest Pass Coal Co. have been slow and not apt scholars in respect to the safety of their mines. We wonder what they will say to the admission by their chief mining superintendent that he had had no previous experience in a "dry and dusty" mine before coming to Fernie; that he had never analysed or otherwise tested the dust in the Fernie mine to ascertain whether it was explosive or not; that he had neither removed nor watered the dust in the old workings because it was "impracticable"; that the only method of watering the dust was with "a car and a can," and that "the explosion may have resulted from his inability to remove or water the dust in the old workings," although he travelled them for purposes of inspection. The overman frankly admitted that the explosion may have resulted because of the ignorance of himself and the other officials as to the truly dangerons character of the dust, and this is the most charitable conclusion which can be drawn. But in all matters affecting the safety of human life, ignorance, which is the result of unacquaintance with what any official undertaking the direction of such matters should know, is culpable, if not criminal, negligence for which his employers are responsible.

The recommendations of the jury indicate with admirable perspicuity the other glaring omissions which have characterized this "management," and we have little doubt the Government will give effect to them without a moment's delay, as they are the practical working out of principles recognized in mining practice in Great Britain

more than ten years ago. One of the chief officials of the company stated during the progress of the enquiry that the explosion would cost them, directly and indirectly, $500,000, or the equivalent of two year's profits based upon the last annual report. We do not doubt it, but it is a small price to pay for the experience acquired compared with the heart-breaking sorrow represented by 130 mounds on a little hillock behind the town of Fernie.

VERDICT OF THE COKONER'S JURY.

The coroner's inquest upon the death of Steven Morgan, Joseph Sangalla, and Wm. Robinson, came to a close today, and the jury, after being out for seven hours, brought in the following verdict :—

"That the said Steven Morgan, Joseph Sangalla, and Wm. Robinson came to their death on Thursday, the 22nd day of May, 1902, at or about the hour of seven-thirty o'clock in the evening, in what is known as numbers two and three mines, situated on Coal creek, near the town of Fernie, in the province of British Columbia, the property of and worked by the Crow's Nest Pass Coal Co., Limited ; that we, the said jury, find the initial cause of the explosion, being at a point in the No. 2 mine aforesaid, not clearly defined, and that said initial cause extended from the said undefined point throughout the greater portion of No. 2 and 3 mines, by coal-dust being the conveying medium; and we find in consequence that the inadequate method of watering and removing of the dust left the mine in such a condition as to be dangerous, and thereby providing a medium whereby the initial cause was augmented and intensified ; that we, the said jury, recommend the Government to take such steps to enforce : 1st, the immediate installation of the most approved system of watering for allaying dust in coal mines ; 2nd, that a more thorough inspection be adopted at these mines, throughout the old workings and rooms contiguous to the air channel that are not being worked ; 3rd, that the safest explosives and most approved safety lamps be used.

(Signed) "A. H. CREE, *Foreman.*
"J. D. QUAIL,
"J. H. BRICKER,
"J. L. GATES,
"J. MILLS,
"J. L. McINTYRE."

Safety Lamps and Colliery Explosions.

By JAMES ASHWORTH, M.E., Mount Chaddesden, England.

The fearful explosions which are continually occurring in various parts of the world, notably that of the Universal Colliery in South Wales, the Fraterville coal-mine in Tennessee on the 19th of last May, and lastly the one at the Fernie No. 2 tunnel workings of the Crow's Nest coal field, on the 22nd of May, about 7.30 p.m., are sufficient in themselves to cause those who have the charge of mines which give out firedamp, as well as those who have money invested in them, to seriously consider in what way this risk may be lessened, if not almost totally prevented.

It is suggested by the newspaper reports on the Fernie disaster, that the explosion originated from blasting in the coal. Similarly it was also suggested that the explosion at the Universal Colliery, Senghenydd, was caused in a similar way, but in the latter case only one witness could be found to suggest that an explosive had originated the disaster, though many witnesses proved that it could not have thus originated, and that it was in all probability caused by a totally different cause, and in a totally different part of the mine. The other cause and in all probability tbe true one, was the failure of a safety lamp to prevent the flame inside the lamp igniting the firedamp outside.

Under the Mines Regulation Acts of Parliament which regulate the management of coal-mines in Great Britain, all the lamps in use must be bonneted, that is to say, the gauze part of the lamp must be protected by a shield, so that an explosive air current cannot impinge directly on the naked gauze and cause it to become so quickly overheated as to destroy its protective value. Experiments have proved most conclusively that gauze lamps of the Davy type, such as the old Scotch gauze lamp, cannot withstand an explosive current of the lowest velocity on account of their large cubic contents, because the ignition of a large volume of fire-firedamp exerts such a high velocity that the flame is forced through the mesh of the wire almost instantaneously, and without waiting to overheat the gauze. In like manner the naked Davy lamp which was in use by deputies, firemen, and shot firers for so many years throughout Great Britain, and was almost universally trusted by mine officials as the best lamp to use for the detection of fire-damp, and also as the safest lamp for a workman or miner to use, was frequently condemned by experimentors until the Royal Commission on Accidents in Mines made experiments, and finally condemned the lamp as unsafe and reported that where used it must be protected by a shield covering the whole gauze. So great a favourite has the Davy lamp been in the hands of mine officials, that it is still in use in some mines in its original form (Fig. II), and in others when protected by a metal and glass glass shield, the glass being moveable as shown in the section Fig. III. Where the Davy lamp has not been in use for detecting firedamp the Stevenson (Fig. IIa) and the Clanny (Fig. IV) lamps have been used, but as these are as unsafe as the naked Davy, they also have been put to one side, excepting the latter when bonneted as shown in Fig. V.

The safety value of the Davy and Clanny lamps, both naked and bonneted, is well known so far as their exposure to explosive currents



FIG. I.—Scotch Gauze Lamp.

of air and firedamp are concerned, but when we expose them to mixtures of air, firedamp, and coal-dust, the latter factor completely upsets the confidence which the official tests of safety lamps in mixtures of firedamp and air have heretofore inspired. Thus, in the North of England Institute of Mining and Mechanical Engineers' transactions so long ago as 1880, a paper on Improved Safety Lamps of the Davy and Mueseler types will be found, in which it is shown by most careful experiments, which have been checked and verified, that if a mixture of air and firedamp contains only a normal per centage of coal dust, that is, just as much as the slow moving current of 370 feet per minute will lick up from the floor or carry along in suspension, 4½ per cent. of firedamp is sufficient to make the mixture so dangerous and highly explosive that a standard Davy lamp with a tin shield will pass the flame through the gauze in the short space of time of seven seconds. Without the presence of coal dust such a lamp would safely withstand a similar current, containing only 4½ per cent. of firedamp for many hours without failure. Nothing carries convincement to the miner's mind so forcibly as a practical experiment, an

although the evidence of disasters resulting from the failures of safety lamps are not very voluminous, yet they are so definite and accurate in their details that they cannot be pooh-poohed, and treated as *chateau d'Espagne*. Thus Mr. A. R. Sawyer, formerly an assistant inspector of mines in England, and now well known in the South African gold and coal fields, relates in one of his papers contributed to the North Staffordshire Institute of Mining and Mechanical Engineers, that on one occasion he took hold of a miner's Davy lamp, hanging at the face of a slightly dusty working, to examine it, and on giving it a slight tap with his hand, there was instantly a reddish flame of some magnitude outside the gauze, extending to a distance of about two inches. This fact makes it quite clear that if there had been any accumulation of firedamp in this dusty working, Mr. Sawyer would have lost his life, and we should not have had this valuable note out of his book of experiences. Since then many other failures have occurred. For instance, at Bryncoch, South Wales, in 1896, a Davy lamp failed in a very low velocity of current which had become fouled by a heavy fall of roof in another part of the mine. Many other explosions resulting from the failure of Davy lamps to withstand conditions which are frequently to be found in most coal mines, might be added, but need not be further referred to, as the Clanny type of lamp was the one in use at Fernie, and failures of this type will probably be of greater interest to Canadians.

At the Whitfield Colliery, North Staffordshire, in 1886, a Mueseler lamp (Fig. VI), which is a safer lamp than the Clanny, and is under ordinary circumstances automatically extinguished by an explosive current, failed entirely to resist what may be termed a very practical test. The lamp in question was hung on the side of a heading in the Cockshead mine (which is a thick coal having an inclination of about one in four), and the collier who was working by its light was moving dirt out of an old level into which he had thurled. Whilst doing so a

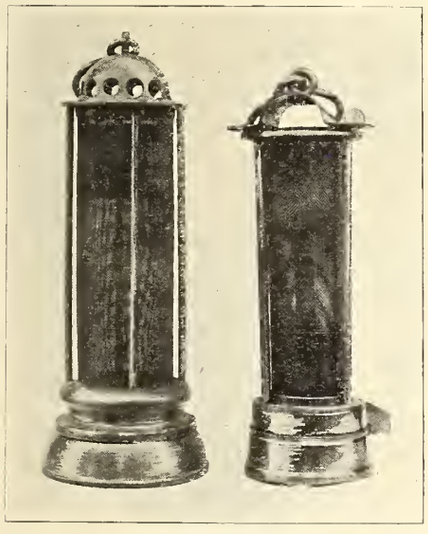


Fig. II.—(a) Davy Lamp. (b) Stephenson.

slight fall of roof took place in the old level, bringing down with it a small quantity of gas and dust, which, on coming in contact with the lamp, immediately exploded, and burned the man slightly. The lamp was carefully examined after the explosion, and was found to be quite correct, and to all appearances safe, but it was noticed that the lamp gauzes were perfectly clean, and as bright as a shilling, whilst another lamp hanging close against it was found to be very dirty from the dust.

To show that experimental results are often confirmed by practical demonstration may be shown by the failure of a double gauze Marsaut lamp. The inventor of this type of lamp, in his book on safety lamps, states that he obtained one failure out of every nine tests with similar lamps when they were suddenly surrounded with an explosive mixture of firedamp and air. At the Wishaw colliery, Scotland, in 1895, an unbonneted Mueseler which was being used to test by a fireman for firedamp in a narrow heading partly ventilated by the exhaust from an engine worked by compressed air, suddenly passed the flame through both gauzes without the lapse of any appreciable interval, and immediately exploded the accumulated firedamp. Several miners who were present and saw what occurred were waiting to go into the heading to fetch out their tools, but no one was killed.

Passing on to the modern type of Clanny, viz., the one known as the bonneted Clanny, we find that at the Allerton Main colliery in Yorkshire in 1894, whilst several men were engaged in placing, and also replacing some air pipes which were used to ventilate a heading through a fault, an explosion was originated by the failure of a bonneted Clanny lamp to withstand a mixture of air, firedamp, and

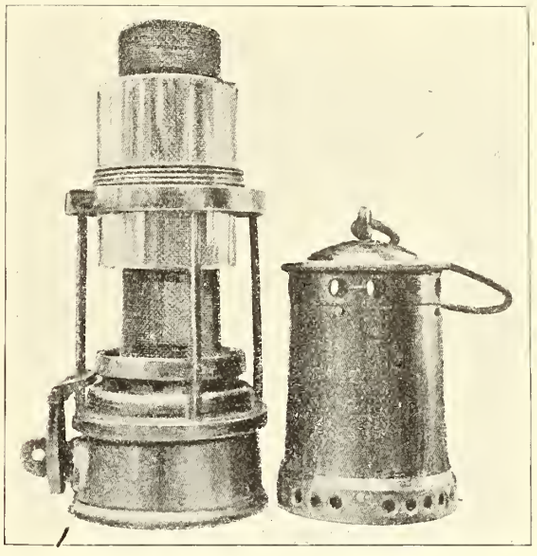


Fig. III.—Cambrian Davy Lamp for Firemen, showing glass part raised and the bonnet removed.

dust, moving at a low velocity. These lamps were afterwards submitted to Prof. Lupton, of Leeds, who tested them in high velocities of mixtures of firedamp and air, but without coal-dust, and failed to make them explode the outer atmosphere.

Another notable failure of a bonneted Clanny occurred at the Shakerley Colliery, Lancashire, in 1895, where a party of officials were engaged in trying to move an accumulation of gas by clearing an airway. All the lamps had been extinguished excepting one, and the man who was using it was practically in a quiescent atmosphere, but the heading being old and very dusty, undoubtedly dust, disturbed by the movements of the men, was a factor, along with the mixture of firedamp and air, in causing this one lamp to fail and explode the mixture. Every man present was instantly killed. The lamp which had failed was tested by Mr. Hilton, of Wigan, who had had considerable experience in the testing of safety lamps, but he could not explode it in any of the mixtures of fire-damp and air that he used. We may particularly note that in these experiments, as in those on the Allerton Main lamps, no coal dust was added to the explosive mixture.

In the year 1901 we have the suggested failure of either a bonneted Davy or of a bonneted Clanny at the Universal Colliery, South Wales, in a mine which was both fiery and dusty, and in which men were engaged in one part of the mine, as at Allerton Main, in adding air pipes to ventilate a heading through a fault. Later in the same year, viz., on December the sixth, a non-fatal explosion of gas occurred at the Shirebrook Colliery in Nottinghamshire, which was worked exclusively with locked (magnetic locks) double gauze bonneted lamps of the Wolf type, Fig. VII. And the following is the Inspector of Mines' report on the occurrence :—

"A night shift of workmen was sent to do some road repairs near the coal face, and near a fault. The place to be repaired was a breakdown of the roadway, leaving a high cavity in the roof. An official of the mine visited the place at about 11.15 p.m., and reported that he found no gas, and the men continued at work until "snap" time. They had just resumed work when the gas was ignited.

"The injured person had taken his lamp and placed it upon a bar about 8 feet 6 inches from the ground, whilst he stood upon a tub to fix some timber across the cavity above the bar. While doing this work an explosion of gas occurred and burned the man who was standing upon the tub. The other man was uninjured, but a number of men ran to the shaft in a panic. The explosion set fire to two brattice sheets and a wood pack, and so quickly did the fire extend that but for the energy of the officials and the use of hand grenades the fire would probably have soon been out of control, and have become exceedingly dangerous.

"After the extinction of the fire the firedamp again appeared, indicating that the fall of roof had liberated a small feeder from the fault. The lamp which was supposed to have fired the gas was carefully examined, but no serious defect was found."

This lamp was afterwards tested in an explosive mixture of gas

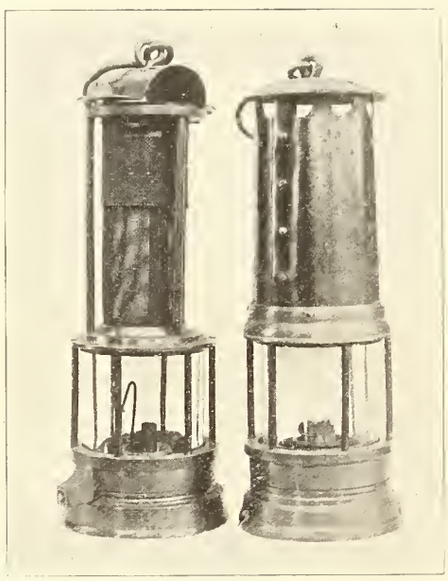


FIG. IV.—Clanny Lamps.

and air without any failure. There was no appearance of overheating, and the gauzes were clean and free from dust.

These instances might be greatly enlarged if problematical cases were added, but no event, as originating a colliery explosion, is so difficult to prove as the failure of a safety lamp, because the principal indication is not necessarily the evidence of an overheated gauze, but rather its great cleanliness as compared with other lamps in the immediate vicinity. This fact would, in the opinion of most people, be the most convincing proof that it had not failed. Experiments, as well as practical experience, has proved that the most dangerous condition to which a safety lamp may be subjected, is when the lamp is suddenly raised into an explosive atmosphere of firedamp, air, and dust, or when a ventilating current becomes suddenly charged with an access of fire-damp, or approaching the lamp from the top crushes down the wick flame. From this proving, mine officials will readily understand that any lamp which admits of a down current, and the crushing down of the wick flame, cannot be a safe lamp to put into the hands of officials who have to examine the mine for gas, or who have to make careful tests of the place, and also the adjoining places to that in which a shot or shots may have to be fired.

There are many sorts of lamps which are called deputies', firemen's, and shot firers' lamps, but very few of them are really safe to use under the conditions which surround the work of these officials. Yet there is one type of lamp which came out of the Royal Commission on Mine Accidents tests with distinguished honour, viz., the one known as the

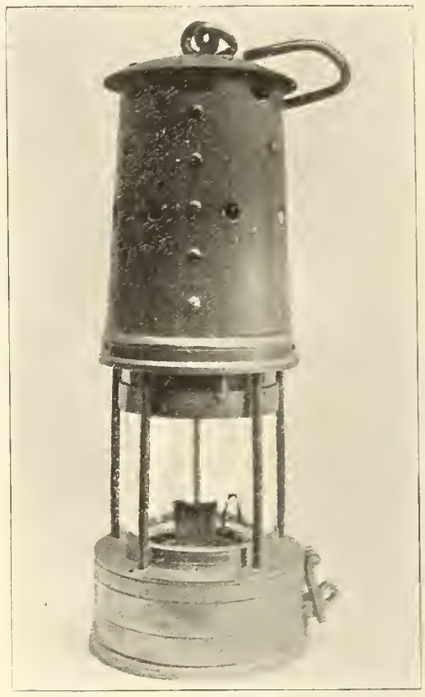


FIG. V.—Bonneted Clanny, Mueseler or Marsaut. Arrangement for gas-testing.

Gray. So impressed were the Commissioners by the suitability of this type of safety lamp for gas-testing, that one of the Commissioners, Prof. Clifton, tried to improve it. After the publication of the report an improved form was brought out by the writer, who has had a life-long experience in experimental work with safety lamps, and also in their practical use, and this lamp is well known throughout the English coal-fields and also in the colonies, as Ashworth's patent Hepplewhite Gray (Fig. VIII). The lamp, as thus improved, did not find the favor it might have been expected to have done in the fiery mines of South Wales, and so late as 1901 the original inventor, Mr. Gray, again took out a patent, which he calls No. 2, combining all the best points of the Gray and Ashworth lamps. Very long and careful



FIG. VI.—Mueseler Lamp.

practical experiments have been made with this lamp, and Mr. Gray may be congratulated on being able to provide his officials with such a valuable, simple, and useful safety lamp with which to ascertain the

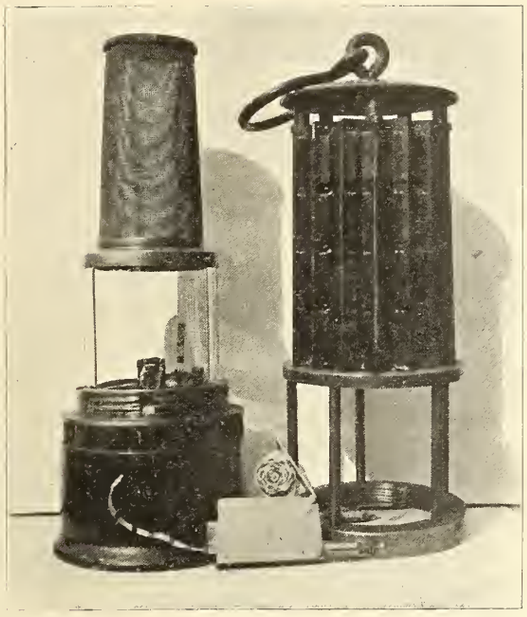


FIG. VII —Wolf Lamp. Illuminant Benzolene. Showing arrangement for lighting without opening the lamp. Magnetic locking.

real state of a mine, and which produces such a good illumination that it is a pleasure to pass along the roadways of a mine where everything can be clearly seen, and the old idea of groping about a pit with the miserable light of a Davy lamp is no longer necessary. This type of lamp may be so constructed that it will be automatically extinguished when in a miner's hands if the air current becomes in any way fouled by a percentage of firedamp which would be indicated only faintly on the flame of a Davy lamp. It is also impossible to produce a down current, that is, to reverse the air current within the lamp, so well are the inlet and outlet air openings protected, and the lamp may be carried in any current of air without its being extinguished. Fig. IX shows

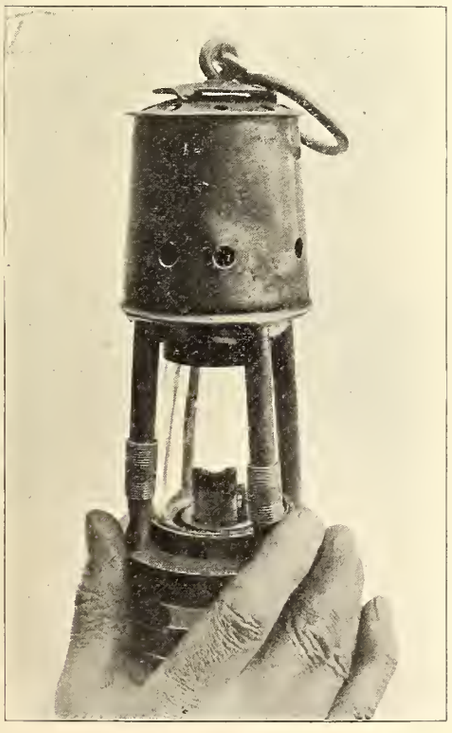


FIG. VIII.—Ashworth's patent Gray, Deputy or Fireman's Lamp. Showing mode of manipulation when testing for firedamp.

the lamp in sections, and on reference to this it will be seen that when the lamp is not being used for the purpose of gas detection all the air required for combustion, and to keep the lamp cool, enters directly above the cylindrical glass, and, passing down the four air tubes which replace the ordinary solid standards connecting the top part of the lamp with the bottom, goes through the ring gauze below the glass, and after supplying the wick flame, finds its escape with the products of combustion through the conical tin chimney, and then, as an extra protection through the slightly conical gauze which entirely covers and surrounds the chimney, and finally into the surrounding air through the double deflector openings in the top of the shield, as well as through a hole in the extreme top of the shield, which is perfectly protected from all down or angular currents by the baffle plate to which the handle is attached. As no mining laws in any part of the world make any stipulations with regard to the percentage of firedamp which a safety lamp shall be capable of detecting, it is only necessary to say that this lamp will detect more readily, and with greater certainty, the presence of the "blue cap" than any Davy lamp which was ever made. When the fire boss, fireman, deputy, or other official wishes to make a

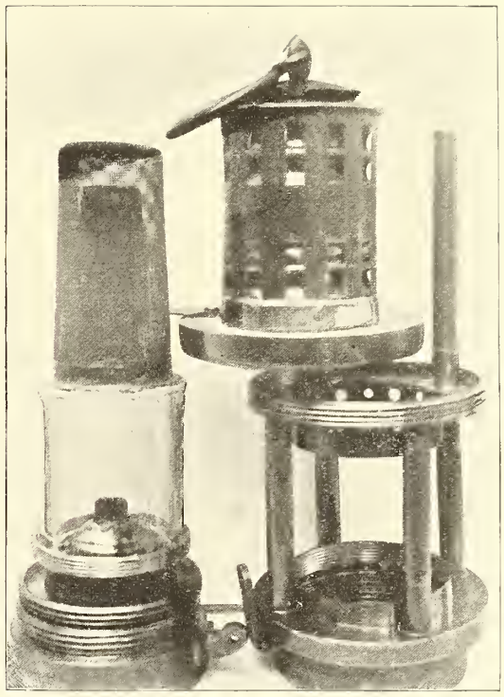


FIG. IX.—Gray's No. 2 Patent Safety Lamp for Deputies, Firemen or Miners. Showing gas-testing tube in position. Lead lock. Gives a particularly good light. Illuminant—paraffine or mineral colza.

test for fire-damp, he puts his hand in his pocket, and, taking out a short brass tube, places it on to one of the fixed air tubes, and is thus enabled to test the condition of the mine close up to the roof, without canting the lamp. If firedamp is present, it passes down this single tube, and is indicated on one side of the wick flame without extinguishing it, and no form of bonneted Davy, Clanny, Mueseler, or Marsaut can make such a close test either so quickly or so accurately.

If such a lamp as this had been in use at the Fernie mines, it would have been impossible, excepting with the grossest and most criminal negligence, to have allowed a shot to be fired when the mine was in an unfit state for shot-firing. Not only is a mine jeopardized by inaccurate examinations for firedamp, but by the class of workmen employed, as stated in the CANADIAN MINING REVIEW in the issue of February 28th, 1901. That this risk is not confined to the Fernie mines was amply demonstrated by a recent explosion in a pit near Wigan, England, where the contractor for the work, finding that the pit was dangerously fouled with firedamp, sent all the safety lamps

out of the pit, and left his men to continue their work by the aid of electric lamps coupled direct to acable from the pit top, but during the shift, a Pole, who could not read English, struck the main cable with his spade, causing a shortcircuit and an arc which originated an explosion of the accumulated firedamp, and which killed nearly every man in the pit, as well as the man on the top of the pit. Judging from the plan of Mine No. 2, printed in the CANADIAN MINING REVIEW, of the 31st of March, 1901, it would appear that an electric pump was at work in a place ventilated by return air, and in the immediate vicinity of a large area of gob, which, if unventilated, as shown, could not fail to be a source of very great danger, and would make the examinations of firedamp of even greater importance than in a mine where electricity was not in use.

A mine at such a high altitude above the sea must present points of great scientific interest. Thus, the barometrical pressure is very low compared with English fiery mines, showing a difference of at least six inches of mercury, and probably the air is very dry, therefore, if a low barometer indicates a danger, the dry state of the air compensates the danger to some extent. And moreover, as every cubic foot of air contains less oxygen than in an English deep mine, the proportions of air and firedamp required to form an explosive mixture must be altered also. It is therefore more than probable that the capacity of any lamp to detect firedamp will be lessened by a low barometer, and raised by a high barometer, because the heat of the testing flame will be reduced by the low barometer. Under like circumstances, the lighting power of safety lamps will be reduced, and if candles have to be abandoned an ordinary type of safety lamp like the Clanny will be a poor substitute.

The capacity of a safety lamp to detect small percentages of firedamp depends entirely on its heat and its non-luminosity, but principally on its heat, and these are the reasons why hydrogen gas and alcohol spirit were adapted by the writer to his Hepplewhite-Gray type for laboratory and main air current testing in coal mines.

In conclusion we should recommend Canadian colliery managers to carefully consider the subject of gas detection, and thus provide against the horrors of colliery explosions as well as against the great loss of capital which these disasters inevitably cause.

ASBESTOS MINING IN QUEBEC.

Mines which Employ over 3,000 Men, and that have Paid Handsome Dividends for many Years.

Supplementing the interesting article on Canadian asbestos, reproduced in this number of the REVIEW, and as contributory to the excellent series of photos which form our illustrated supplement, a few notes concerning the companies and operators who constitute this most successful and highly profitable Canadian mining industry may be of interest.

Although the areas of the Serpentine, in the townships of Thetford, Coleraine, Ireland, and Wolfstown are very extensive, the portions in which asbestos is found are comparatively rare, and the mining, though now prosecuted for nearly twenty years, is practically confined to two small sections a few miles apart. The first, and as yet the most important of these, is a small mound near the Thetford station on the Quebec Central railway, which rises about 80 to 90 feet above the track; the other, the bold ridge of brownish-looking rock to the south-east of Black Lake station, which assumes much greater prominence, and probably has an elevation of 650 to 700 feet above the railway at this point.

Bell's Asbestos Company.

As the visitor to the asbestos region drops off the train at Thetford Mines station, on the Quebec Central railway, the large quarries and imposing mill of the Bell's Asbestos Company. Limited, arrests attention. This is one of the oldest and one of the largest asbestos mining and manufacturing undertakings in the world. The company was registered in London on 4th May, 1888, to take over the business of John Bell and Sons, asbestos manufacturers, and the freehold asbestos estates at Thetford, Hayden, and Belmina, in the townships of Thetford and Coleraine. For the mines, then only partially developed, the company paid: £8,394 for Belmina, £41,300 for Thetford, and £8,000 for Hayden. The mines are admirably equipped with a thoroughly up-to-date mining plant, comprising Norwalk 12-drill compressor, six Ingersoll and four Bacon hoisting engines, nine Ingersoll-Sergeant rock drills, nine cable and four boom derricks, Blake and Worthington pumps, rock breakers, etc. The large mill was enlarged and rebuilt to meet the greatly expanded production of the company last year, and is equipped with a first-class plant for mechanical separation of asbestos, including rolls, crushers, picking tables, screens, and cyclone mills. In 1895 the then existing shares of £5 were subdivided into five shares of £1, and the share capital is now £700,000, of which £170,000 has been issued and paid up in full. Large profits have been earned annually from the working of the company's mines, and the dividends paid have been as high as 22½ per cent.

Much of the success of this large undertaking has been due to the skill and untiring energy of Mr. George R. Smith, M.L.A, the company's manager. Mr. Smith has been prominently identified with active mining in Canada for nearly twenty years, and since he succeeded the late Tom Sheridan in the management of the Bell's Company's property many important improvements and economies have been effected by his mechanical ingenuity. For instance, the uniqne type of locomotive shown in our photo was evolved practically from the scrap heap, a dismantled hoisting engine being converted by Mr. Smith's ingenuity into a handy and serviceable locomotive, hauling rock from the quarries to the mill. From this model Mr. Smith has recently turned out the handsome little locomotive No. III, shown in our illustrations, and, indeed, the type has proved so well adapted to the work of these quarries that it has been introduced by the neighbouring companies, and its manufacture forms one of the special features of the large shops of the Jenckes Machine Co. at Sherbrooke.

Mr. Smith, as everybody in Quebec knows, represents the County of Megantic in the Quebec Legislature, having been elected as a supporter of the Government, in succession to the late Mr. James King. He is also a member of the Council of the Canadian Mining Institute, and is chairman of the Eastern Townships branch of that important organization.

Beaver Asbestos Company.

Adjacent to the Bell's property is the fine new mill and mine of the Beaver Asbestos Company. This was originally a syndicate of Eastern Townships people, but it is understood that the controlling interest in the property is vested in Mr. R. H. Martin, of New York, the well-known American operator in asbestos, and for many years one of the principals of the H. W. Johns Manufacturing Company. The mining property comprises about 200 acres, and, as at the other mines, the works are open-cast, boom and cable derricks being used for hoisting. An excellent working plant has been installed by Mr. Harry J. Williams, the manager, who has been associated with asbestos mining almost since its inception. This mine employs about 150 persons.

King Bros.

Thfs old-established Quebec firm of lumber merchants were among the early pioneers in asbestos mining in Quebec, and their

mines at Thetford and Black Lake have gained a world-wide reputation for the exceptionally fine quality of their various grades of asbestos fibres. The company own a large mineral property extending over something like 21,000 acres, in the Townships of Thetford and Ireland, but its principal operations are at Thetford Mines, where a complete mining and milling plant is operated under the administration of Mr B. Bennett.

Johnston's Company, Limited.

This company was the first, if our memory serves us, to engage in asbestos mining, the present company being incorporated sometime later, about the year 1885. It has an authorized capital of $250,000, in shares of $500, and very large profits have been distributed among the shareholders, almost from the first year of its existence. This company operates, in addition to its well equipped mines, two large mills at Thetford and Black Lake, and the various grades it puts upon the market realize very handsome prices. Mr. Andrew S. Johnson is the managing director, the other principals being entirely composed of Quebec people. Very large prices, extending into the millions of dollars, have been offered for the purchase of the Johnson and King mines, but the owners know when they have a good thing and the properties are not on the market.

Union Mines.

This mine is situated about a mile from Black Lake station, a short distance over the way from Thetford, and will be remembered as having for several years been worked by the Wertheims, under the management of Mr. L. A. Klien. The present owners are also Germans, the head office of the company being at Hamburg. The mine is situated on Lots 27 and 28, South Half, Range B, of Coleraine, being worked open-cast and by two tunnels in respectively 200 and 300 ft. The mining plant comprises a Rand 7-drill compressor and drills, 7 hoisting engines of various types, Northey, Blake, and Snow pumps, Blake breakers, etc., power being supplied by 4 boilers, two of 40 h.p., one 90 h.p., and one 25 h.p. The milling plant includes a 25 h.p. Corless engine, crushers, screens, elevators, picking tables, rotary dryer, etc., etc. Mr. T. H. Crabtree is the local manager of this excellently managed mine.

Standard Asbestos Co.

Another well-known producer at Black Lake is the Standard company, organized in 1901, with a capital of $150,000 in shares of $100, to take over the mine, worked for several years, by the Anglo-Canadian Asbestos Co., Limited. The property extends over 325 acres, forming part of Block A in the Township of Coleraine. The mining plant is largely of the Rand Company's manufacture, and a finely equipped fibreizing mill has been put into commission equipped with all the latest mechanical devices for turning out the various grades of asbestos. Mr. R. T. Hopper, who was the directing spirit of the Anglo Canadian Company in Canada, and who may be said to be the pioneer of asbestos mining in Black Lake, is the managing director of the Standard, and his mine captain is Mr. W. A. Clerihue.

Canadian Asbestos Co.

This company operates the property and plant of the old Glasgow and Montreal Asbestos Company, Limited, at Black Lake. Since taking possession the mining and milling plant has been overhauled and new sources of asbestos, it is reported, have been uncovered. The company, which is largely composed of Montreal people, is managed by Mr. Wm. Sclater.

Manhattan Asbestos Co.

This company, organized in 1901, is working over the old ground of the United Asbestos Company, and is a combination of American and British capital. In addition to a very complete mining plant, a modern mill has been installed. The property upon which the mine is operated covers some 75 acres in Block A of Coleraine. The capital of the company is $120,000 in shares of $100.

The Kerr-Murphy Mine.

On Lot A 31 of Coleraine, owned by Mr. A. H. Murphy and associates, Mr. Kerr is doing some preliminary development, it is said with such satisfactory results that a mining and milling plant will very soon be placed in commission. This, up till recently, was practically a virgin lot upon which no work had been done for a great many years, and then only upon a very small scale.

Dr. Reed's Mine.

Dr. James Reed, of Reedsdale, Que., is the owner of some asbestos property at Black Lake, upon which some mining has been done and a small mill built.

East Broughton Asbestos Manufacturing Co.

About a mile distant from East Broughton station, on the Quebec Central railway, is the Williams mine, which was reopened last year by the East Broughton Asbestos Manufacturing Co., and a small mill put up.

Asbestos and Asbestic Co., Ltd.

The most westerly area in the eastern townships in which the mineral is mined is the old Jeffrey mine, four miles east of Danville village, on Lot 9, Range 3, Shipton, operated on an extensive scale by the Asbestos and Asbestic Co., Limited, an English syndicate having a capital of £500,000. This company was exceedingly unfortunate in losing its large mill by fire in March, 1900, and the mine was shut down for the greater part of that year in consequence. A new mill has since been installed and the company is again shipping large quantities of asbestos. It also makes a specialty of the manufacture of asbestic, or ground fibrous serpentine, a product admirably adapted for fire-proofing material. The controlling interest in the company was acquired in June, 1900, by Mr. James P. Cannon, of New York, who furnished the bulk of the capital for the re-equipment of the mine and mill after the fire. The mining plant is largely of the Rand pattern, and the milling machinery on much of the same principle as that in vogue at Thetford and Black Lake. Mr. James R. Pearson is the managing director of the company's affairs at Danville.

The asbestos here occurs in a rounded knoll, one of a series which extends from Melbourne through Cleveland into the south-east corner of Tingwick, and is the only one in which valuable veins have yet been found in this direction. This was first worked in 1884, and has yielded a large amount of asbestos of excellent quality.

Columbia and Ottawa Asbestos Co.

In connection with the Laurentian rocks of Ottawa County, the serpentinous limestones sometimes carry veins of a pale yellowish asbestos, generally of short fibre, but at times having a length of three-fourths to one inch. In some pieces of rock several of these, six, eight, or more are found, occupying a breadth of ten to twelve inches, the thickness of the veins ranging from one-fourth of an inch upward. Few attempts have been made to work these asbestos veins, the only production coming from a mine worked by some Ottawa people, in

the township of Low. This property was turned over to the Columbia and Ottawa Asbestos Company this year, and it is now, we understand, to be worked systematically.

GROWTH OF THE INDUSTRY.

In 1879	300 tons,	worth	$ 19,500
" 1880	380 "	"	24,700
" 1881	540 "	"	35,100
" 1882	810 "	"	52,650
" 1883	955 "	"	68,750
" 1884	1141 "	"	75,097
" 1885	2440 "	"	142,441
" 1886	3458 "	"	206,251
" 1887	4619 "	"	226,976

For the past five years Mr. Obalski gives the returns as reported to the Provincial Mining Bureau as follows:

1897	25.365 tons,	valued at	$ 380,000
1898	23,015 "	"	511,256
1899	23,266 "	"	598,736
1900	29,433 "	"	735,364
1901	40,397 "	"	1,284,429

About 3,000 men are employed and the invested capital will will aggregate at least about four millions of dollars.

Trade in Mining Machinery

The opening up and equipment of many new mines throughout the country continues to create an active demand for mining, milling and smelting machinery and all our Canadian shops are well supplied with orders, many of them working double time. The imports for the first four months of the year, however, are somewhat less than in 1901, as will be seen from the following table:—

Month.	1901			1902		
	Free	Dutiable	Total	Free	Dutiable	Total
January	111,134	4,196	115,330	92,984	2,549	95,533
February	162,030	9,689	171,719	43,123	2,380	45,503
March	62,185	806	62,991	55 255	1,720	56,975
April	52,921	517	53,438	61,227	5,579	66,806
Total	388,270	15,208	403 478	252,589	12,228	264,817

1901	From United States		From Great Britain		From Other Countries
	Free	Dutiable	Free	Dutiable	
January	111,129	4,196	5	....	....
February	162,03	9,689	....	....	....
March	58,980	806	....	....	3,205
April	51,971	517	950	....	....
Total	384,110	15.208	955	....	3,205

1902	From United States		From Great Britain		From Other Countries
	Free	Dutiable	Free	Dutiable	
January	65,236	2,549	26,328	....	420
February	42,486	2,380	....	....	....
March	54,980	1,720	275	....	....
April	55,648	4 997	....	....	....
Total	219 350	11,646	26,603	....	420

New Iron Mine at Richmond, Que.—Messrs. MacDougall, of Drummondville, have opened an iron mine under lease on the property of H. Hall, a mile and a half from the Grand Trunk railway station at Richmond, Que The ore is a beautiful hematite, occasionally carrying magnetite crystals, and apparently occurs in small lenses in a dolomite adjacent to a mass of volcanic trap. Somewhat similar occurrences of iron ore are known at several places throughout the Eastern townships, but this is the first to be thoroughly tested.

Forty-third Mining & Milling Co., Limited.—The following circular, under date of 17th instant, was issued to the shareholders:—"Holders of two-thirds of the value of the stock of this company having consented to the issue of bonds, negotiations were entered into for the purpose of having the bonds issued under a guarantee of payment in order to make them more attractive to the investing public. As a result, the Imperial Trustee Company, of New Jersey, has notified the Local Board that it has accepted the trusteeship of this company's bonds, and will guarantee payment of the principal in full. Mr. H. B. Swart, of 29 Broadway, New York, has examined the affairs of this Company and assures a ready sale of the bonds, which he will undertake. The mortgage deed is being prepared, and as soon as ready the Board of Trustees will pass a by-law putting it in force, and the bonds will be placed on sale. The net result to the company will be about $75,000.00. Of this amount $40,000.00 will be used to discharge floating liabilities, and the balance for operating the mine. Everything is being pushed forward as rapidly as possible, and it is hoped that for a portion of this season the mine may be worked. In any case a small party will be sent in to see that no damage to the stores or works results from the delay. Should the shareholders decide that a party ought to be sent into the mine at once, this can be done by their providing sufficient funds for the travelling and other expenses. No outlay for machinery or supplies is needed. Your opinion or suggestions as to this would be acceptable."

Le Roi—Cable from the manager: "Shipment of ores average this month 420 tons per diem, value $15.50. We have struck ore 1,050 west raise $.7 per ton. 900 winze down 64 ft., ore therefrom assays $14."

(Office note.—The raise from the 1,050 ft. level is that mentioned in the monthly report for April, as about to be started to meet the winze coming down from the 900 ft. level). In the report for April, the gold contents should have been given as 56 cents higher, and the copper contents as .10 per cent., not 10 per cent.

Duncan United.—Engineer cables: "No. 5 level, Poorman mine—Driven 22 ft. last week; average width of vein, 2 ft. 2 ins.; average value, $10 per ton."

Snowshoe Gold and Copper Mines.—The following circular has been issued to the shareholders:—"In view of the 5s. call now being made upon the partly paid shares, the directors feel that it would perhaps be of interest to the shareholders to have a brief statement as to the present position. Apart from the vendors' shares, 48,475 shares have been allotted, on which 10s. per share has been paid up, yielding the sum of £24,237 10s.

"Though this company was formed on June 20th, 1901, it, in accordance with the terms of the prospectus, took over the Snowshoe mine and group of properties as from the 1st March, 1901, and has been responsible for all expenditure since that date. Since the new company took over the property, some 2 000 feet of underground work has been done in drifting, cross-cutting, raising, and sinking, thus developing and opening up the large ore bodies already shown up. A large new working shaft is in course of construction, and will shortly be completed to a depth of about 300 ft. This shaft will be capable of handling 300 to 400 tons of ore per day. In addition to this underground work, much has been done upon the surface. A large area of ground has been cleared and stripped, the overlaying soil being removed, thus exposing the ore body near the surface, and making it possible to mine the same very economically. The principal piece of stripping is 360 ft. long by about 80 ft. wide upon an average. It is intended to further continue these operations during the present season.

"Toward the end of last year the directors authorised the erection of a new bunk house and boarding house, and new office and residential buildings for the officials and men employed in connection with the mine. Prior to this, the building accommodation was very inadequate, and consisted mainly of the old log buildings used by the original owners of the property. A considerable amount of machinery has been purchased in order to provide the necessary power and plant to enable the operations of the mine to be successfully carried on. An ore bin with a capacity of 325 tons has been built. The Canadian Pacific Railway runs across the property, and last year a private spur was built to connect with the mine workings and ore bins. Another short spur has been built recently in connection with the installation of the new machinery.

"Test shipments of over 2,000 tons of ore from various parts of the mine have been shipped to the smelters with satisfactory results. Negotiations are now progressing with several smelter companies, who have made prsposals to purchase Snowshoe ore, and provided satisfactory arrangements can be made, it is hoped before long to be making extensive shipments. The directors are giving the most careful attention to the economical treatment of the large ore bodies in the Snowshoe mine, and they have every confidence in being able to deal with these ore bodies at a considerable profit."

Certain Conditions in Veins and Faults in Butte, Montana.

By Wm. Braden, M.E., New York.

In practically all of the great mining centres of the world, faults of more or less extent are found. They are by no means an unwelcome feature to the engineer, as they often form an indication to the vein's relations to its surroundings, and may directly or indirectly indicate the genesis and life of the ore deposits. On the other hand, with certain of those indications lacking (ordinarily caused by metamorphism), which an engineer immediately looks for, much annoyance may be the result. However, faults may be well looked upon as one of the most important and interesting phenomena with which we have to deal, be their influence for good or bad, commercially speaking. And here I should say that the result of research in these channels has been largely prompted by commercial motives. By this it is not intended to belittle the very keen interest which is taken in the study of the problems for the technical interest which it affords, but more often than not the necessary data can not be obtained without heavy expenditures. In Butte, Montana, millions of dollars have been spent before facts have been found upon which a positive theory could be based; and with each succeeding year of underground development facts will be uncovered which will further elucidate the more deep-seated effects and causes, the existence of which in some instances can now only be approximated.

Apropos of the above, while the general geology of the Butte District has been so fully described by Dr. S. F. Emmons, W. H. Weed, and others of the U.S. Geological Survey, in the special Butte folios, in this paper the district will be outlined as briefly as possible.

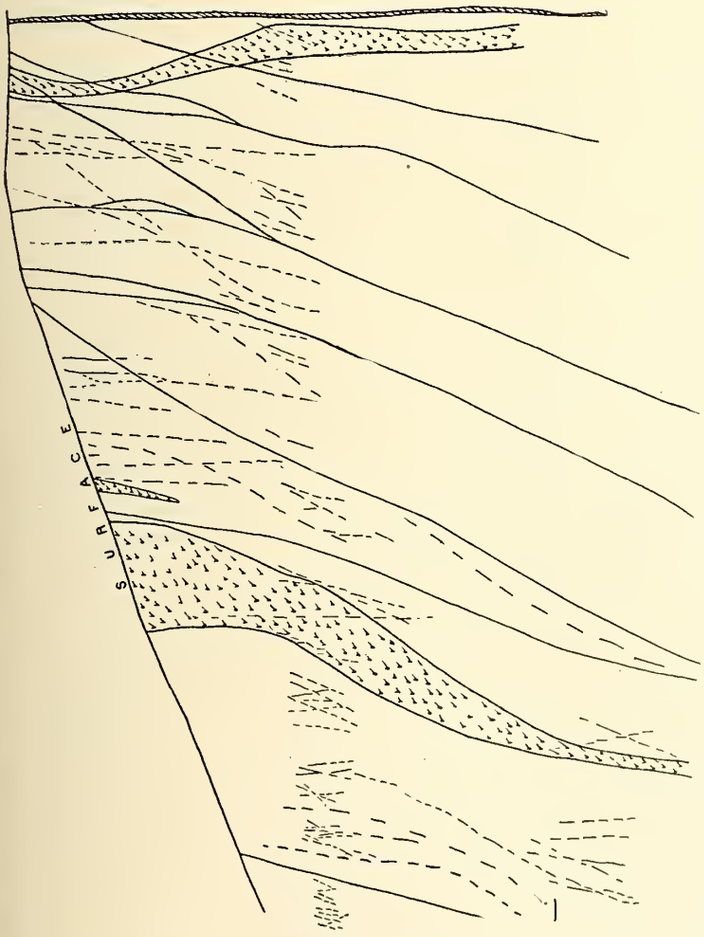


FIGURE 1

Then from the writer's personal observation some characteristic features will be noted, which occur in the midst of a region of great interest to the geologist, mineralogist, and mining engineer, and contain one of the most wonderful vein system or systems wherein mineral deposition has taken place.

The copper bearing veins cover an area of about one and a half miles east and west, along their general strike, by one mile in width. From the alluvium-covered Silver Bow valley to the south and east from the mines, the ground rises some 500 or 600 feet, and with the headworks, dumps, and railroad grades skirting the hill-sides, the appearance is not unlike that of an extensive fortification. On the north and west copper-bearing veins give place to veins whose principal commercial value is silver, with little or no copper; and a short distance from this termination on the west, "The Butte" (from which the district takes its name) rises sharply to a height of several hundred feet. This "Butte," representing as it does the latest volcanic activity in the region, consists mainly of a rhyolytic breccia, which is not penetrated by any of the copper veins; in fact, no mineralized veins being found therein. This rhyolytic intrusion was probably an important factor in some of the post-mineral movements which occurred.

The country rock in the copper mining section of Butte is a basic, much altered and decomposed granite, together with east and west intrusive dykes of quartz porphyry ten to seventy-five feet in width. These dykes have branches and apophyses, and are practically vertical upon sinuous lines. This country rock is widely fissured and fractured.

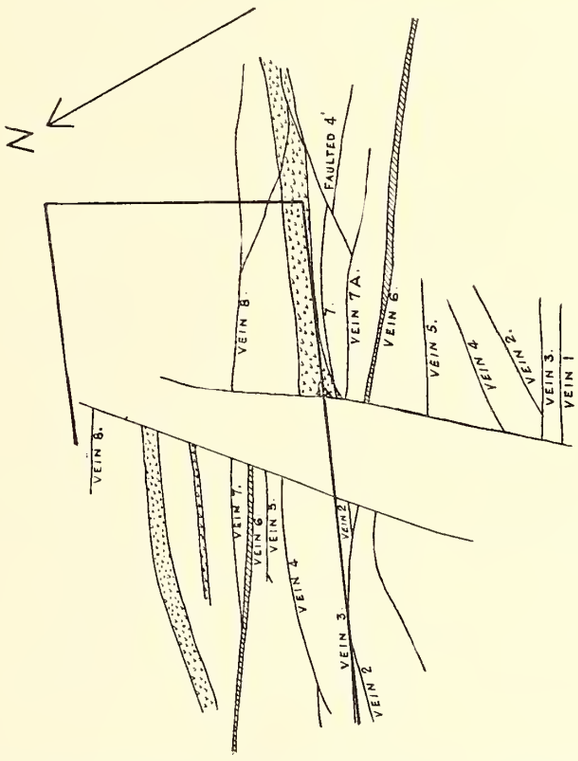


FIGURE II.

The vein fissures have a general east and west strike, oriented within an angle of forty-five degrees. Their dip is usually south, but varies from a slightly north dip to forty-five degrees south. They are mineralized with sulphide ores of copper, accompanied in more or less quantities by quartz and pyrite, sometimes the one predominating and sometimes the other. The mineral solutions have found their way into lesser fractures and jointings, and impregnated the country very considerably. While ore deposition has taken place within well defined limits of the fissures, in what are spoken of as "spaces of discission" by Professor Posepney, the bulk of the deposition has been metasomatic. The veins cross each other and bifurcate both on strike and dip. In some cases these crossing veins fault the earlier veins, and a distinct mineralization is seen in each. For the most part the veins are oxidized for considerable depths from their apices. This oxidization, represented by the present water line, reaches three hundred feet or more from the present surface, but varies considerably in adjacent veins, and is undoubtedly influenced by the individual characteristics of the veins and local conditions of the enclosing rock.

In this connection another feature to this oxidization is the fact that often, in this zone, a very large vein may, to all appearances, show no greater size than a mere off-shoot or fracture in the country rock, the mineralization of which has also been oxidized. It is possible that this effect is produced by either the mere skeleton of the former vein having been crushed in by its unsupported walls; or, in cases where this is especially noticeable, by the fact of little or no mineralization in "spaces of discission" having taken place, but rather a meagre metasomatic action in the country rock, through which the small solution-carrying fissure or fissures passed. It may be conceived that upon oxidization and saturation by the surface waters, the altered and widely-fissured granite and quartz-porphyry would take on much the same appearance as what might be termed the "vein granite." This latter theory is more acceptable to the writer. It is doubtful that secondary enrichment, due to this leaching out of copper and its re-deposition, has taken place, at least from the present oxidized area. If it has, its influences have penetrated to more considerable depths than have usually been spoken of. The writer's observations have been that such enrichment products as found in the Ducktown deposits in Tenessee are either entirely wanting or are quite superficial in the copper-bearing veins at Butte. As recently propounded by Dr. Emmons in his paper upon this subject, it is possible that the present water line is two or three thousand feet higher than formerly, owing to the great fault from what is known as "East Ridge," which, about two miles

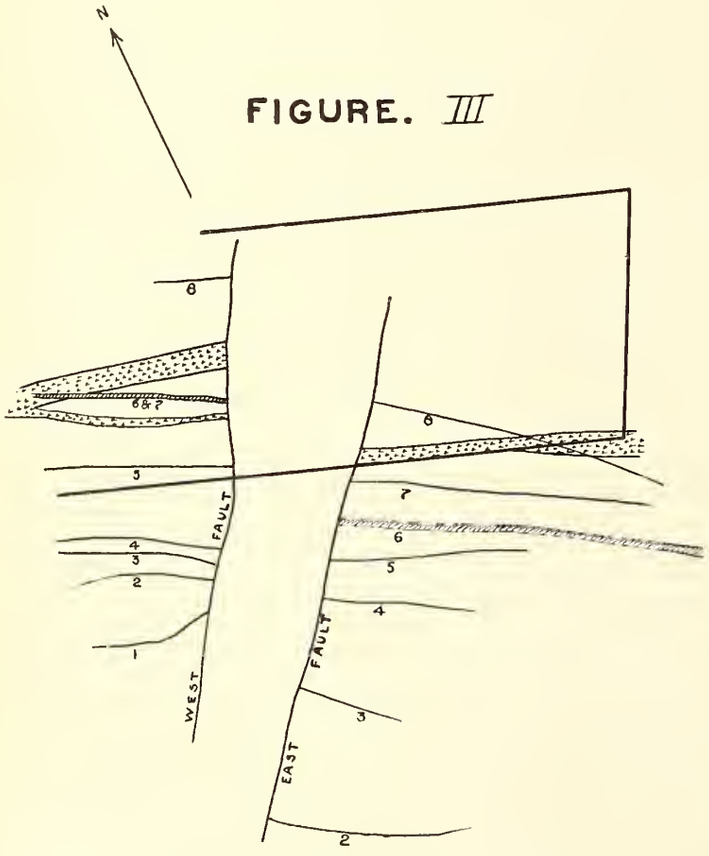


FIGURE. III

eastwardly across Silver Bow valley, rises to an elevation of some two thousand feet, practically in bluff.

Having in mind the general mass of the country as being granite, and the east and west porphyry dykes, and a system consisting of a great number of veins quartering one with the other, so to speak, both on strike and dip a cross fault was encountered in one of the richest sections of the district. The fault was pronounced by the eminent geologist, the late Clarence King, to be a "double normal fault." At the surface, over the course of some hundreds of feet, are two fault planes, from ten to thirty feet apart, practically parallel, though with a tendency to converge at the ends, and with a strike approximately north thirty degrees east. They diverge to the deep so far as developed, the east fault dipping about fifty-four degrees and the west fault about forty-five degrees, both westerly. The extent of the oxidized zone between these two fault planes corresponds with the veins to the east and west of the faults. Between the fault planes, six or seven hundred feet in depth, much crushing, grinding, and kaolinzation is found of the included pieces of veins, as well as the porphyry and granite. As the distance increases to some three hundred feet further in depth, some evidence of regularity is seen; nevertheless the subfaulting and crushing is still pronounced. With this condition and a bewildering geography of underground workings to study, it became

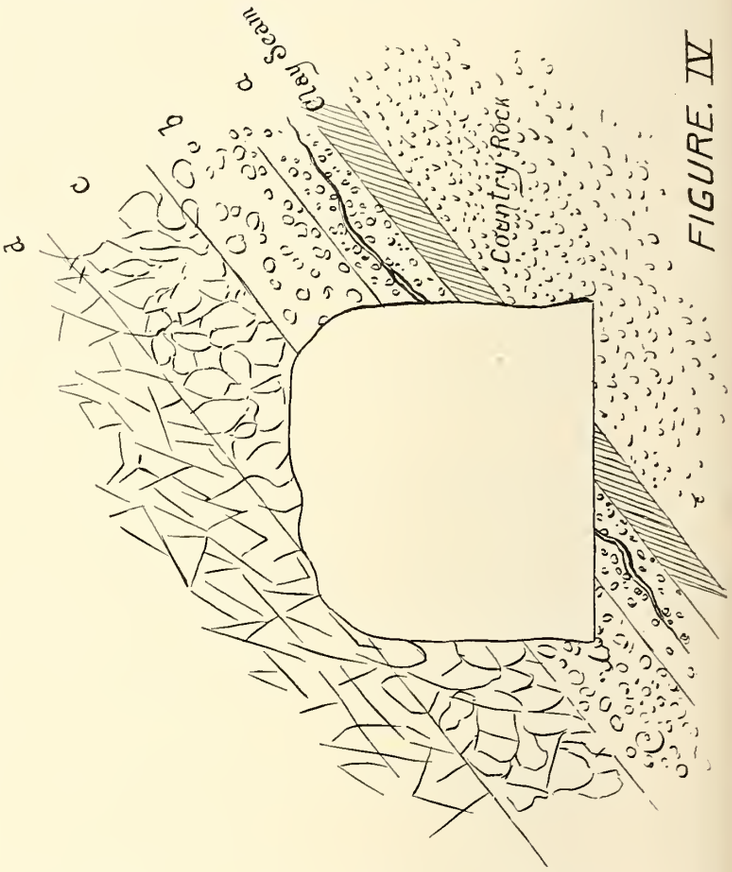


FIGURE. IV

the privilege of the writer, together with a distinguished corps of engineers and geologists, to study the problem of establishing the apices of veins, so that the ownership might be demonstrated under that most enigmatical of United States laws known as the "extralateral rights clause." As an exhibit of the large number of veins and streaks, with their bifurcations and intersections, it is interesting to refer to Fig. I, showing a cross-section of an area undisturbed by the fault movement; and Figs. II and III, showing the 450 and 750 foot levels in plan. Veins not actually shown by workings on these particular levels have been projected either from above or below with tolerable accuracy. Referring to the veins from No. 1 to No. 8 east of the east fault, and veins No. 1 to No. 8 west of the west fault, it is seen that there is evidently no matching or correlation of these, though faulted porphyry is found on both sides of the faults, and between, and would seem to be some definite indication of the heave. But by bringing faces of the porphyry dyke into juxtaposition on the same horizon, we still found nearly as hopeless a condition as before, so far as the veins were concerned. This prophyry was a fairly reliable indicator to the heave, however, as it matched up reasonably well, being practically vertical, but in view of apophyses and bifurcations it gave undoubted evidence of a vertical throw, and the nature and extent of this it became necessary to establish. As the country rock was entirely granite of a more or less uniform appearance (no stratified formation being present), the effort was to study the situation from a standpoint of

different combinations. To be sure there were certain striations, but there were such abundant evidences of subfaulting and crushing, which might prove misleading, and as the granite was quite soft, there were no hardened faces to act as reliable guides in this direction. It was noted that there was considerably less grinding, trituration, and fault rubble upon the western than the eastern fault plane. Figure IV gives a typical illustration of the latter. At the plane there

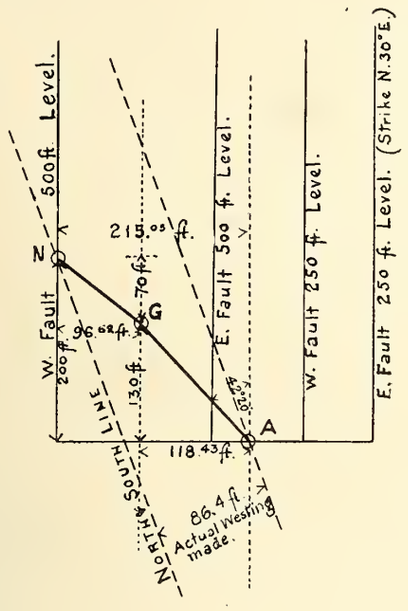


FIGURE V.

appeared a clay selvage, from an inch or two to twelve inches in width. Underneath this the country rock, while somewhat more kaolinized than at some distance east of the fault, was comparatively undisturbed. On top of the selvage appeared :—

(a) Comminuted vein matter, granite and porphyry, with pebbles up to the size of a small nut and sub-selvages ; this for a width of one or two feet ;

(b) For another two feet rounded fragments as much as two or three inches in diameter ;

(c) Boulders sub-angular for two to five feet ;

(d) And finally the angular much broken country rock, porphyry or vein, as the case might be, all very much kaolinized.

Of course, it was found that the porphyry, pebbles, and boulders occurred only north of the porphyry east of the east fault, and on this extended only so far as the included porphyry between the faults.

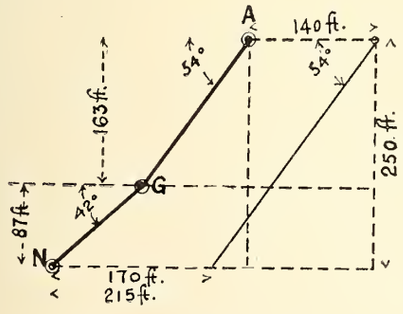


FIGURE VI.

In this connection, owing to metamorphosis, the outward appearance of the material going to make up the fault plane in the oxidized zone often bore a striking resemblance to the quartz-porphyry with its rounded grains of glassy quartz. Interesting samples were collected

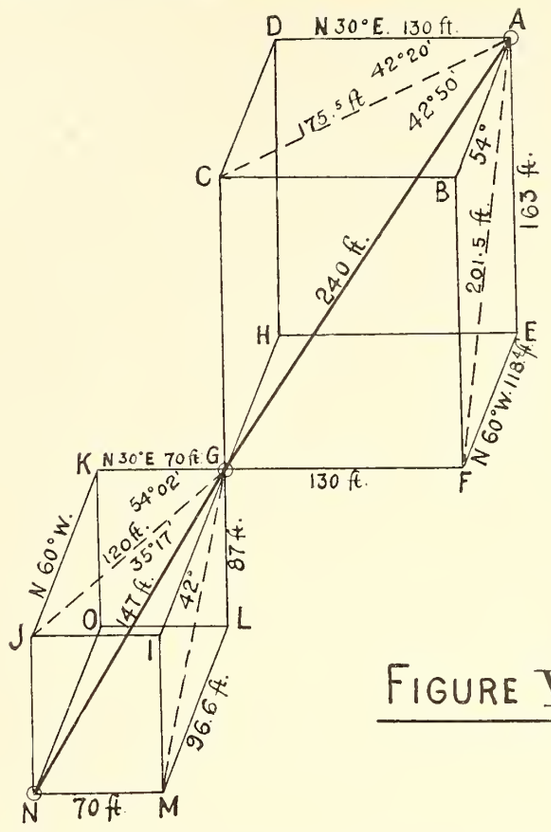
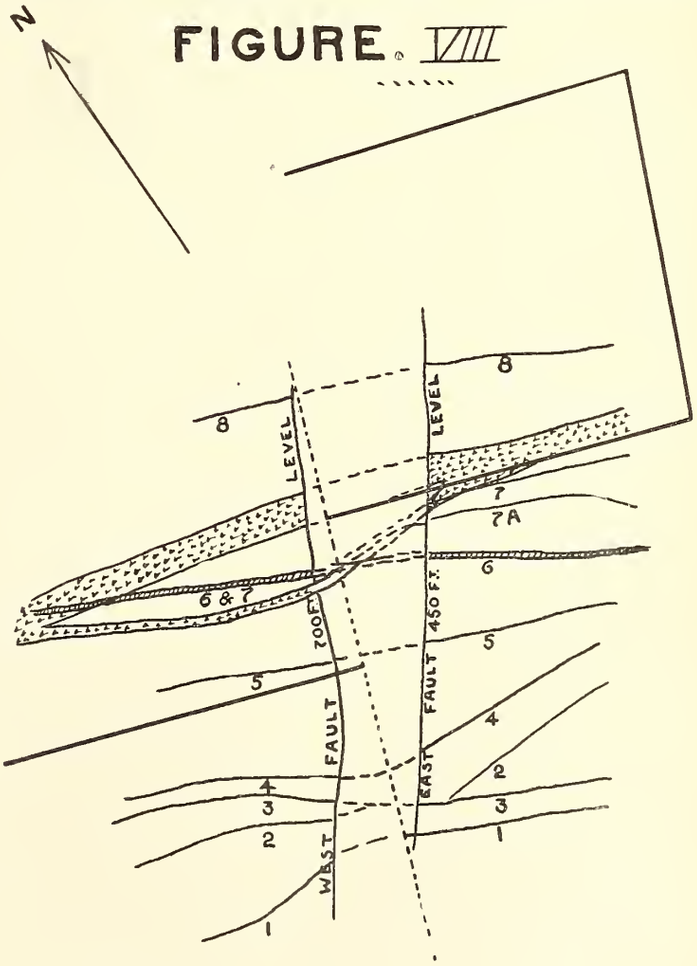


FIGURE VII.

of this material, surrounding included pebbles and boulders of the genuine quartz-porphyry.

Although between the faults were found local complications, it was found possible to gauge the course travelled by the country between the fault planes and west of the west fault plane. In Figures V, VI, and VII the horizontal, vertical, and diagonal courses of movement

FIGURE VIII



are shown diagrammatically, the total vertical distance being some 250 feet; the horizontal distance 200 feet parallel to the fault about north 30 degrees east; the actual or diagonal distance being approximately 387 feet. It will be seen at a glance that the greater movement occurred upon the plane of the "east fault," hence the greater quantity of fault rubble is found therein.

From the very nature of fault occurrence the movement varies from nothing to the maximum. In this connection reference herein is made to an area subject to inspection during the period of the writer's examinations. Undoubtedly the conditions will be altered to the deep, and in extension of the fault at a distance from the immediate region treated of. However, taking any two levels to one thousand feet in depth, wherein the vertical distance of the workings west of the west fault plane were approximately two hundred and fifty feet below the workings of the level east of the east fault plane, it was found a perfect correlation of veins and porphyry dykes resulted by lifting the plan of vein occurrence on the former level up to the level of the latter, and then moving them two hundred feet southerly parallel to the fault. For example: Placing the 700 foot level west workings in juxta-position with the 450 foot level east workings, in accordance with the measurements shown in diagrams Figs. V, VI, and VII, such correlation is seen in Fig. VIII.

With the above data in hand, without going more exhaustively into the line of evidence, it was found possible to correlate the veins by bringing the country between and west of the faults back to what was assumed to be its original position. Vein bifurcations and intersections which, prior to the demonstration of this correlation, seemed obscure, became clear, and vein development could be carried on with practically positive assurance.

Asbestos and its Production in Canada.

By W. Mollmann, M.E., Black Lake, Que.

Amongst the minerals which have gained during the last decade a prominent position in Canadian mining, must be placed asbestos. Commercially, it occurs almost exclusively in serpentine, and possesses such valuable properties as to give it a commanding place in the arts and industries.

Asbestos is a fibrous mineral, in which the fibres are either parallel or divergent. It is often lustrous, and its color varies from white to gray, brown, and green. Amongst its valuable properties may be mentioned incombustibility, flexibility, and ductility, besides it is a non conductor of both heat and electricity. Its resistance to the action of acids is also worthy of note.

The particular prominence that asbestos at the present time has attained is through its resistance to fire. This property was known to the ancients more than 2000 years ago, and asbestos was utilized by them for the wicks of the lamps in the temples and for other purposes.

Now its use has become quite general, and its application for various purposes is continually increasing. Among the uses to which it is put may be mentioned: packing in various forms; covering for steam boilers and pipes; firemen's clothes; theatre curtains; boxes for money and valuable papers; covering for walls and roof; acid filters; powder bags; etc., etc.

As a matter of fact the demand for asbestos has been so great of late years that the opening of new mines has scarcely been able to keep up the required supply. Chemically, asbestos is a silicate of magnesia and lime—however with a fluctuating ratio of its constituent parts. Iron and aluminium are generally associated with it.

The asbestos of commerce contains about 14 per cent. of water, while a variety, which is, however, only of interest to the mineralogist, is almost wholly free from water, or only slightly hygroscopic.

The following table, taken from the admirable work "Asbestos and Asbestic" of R. H. Jones, of Montreal, gives the analyses of the principal kinds of commercial asbestos.

	Italian Fibre.	Canadian Fibre.	
		Thetford.	Broughton
Silica	40.30	39.05	40.87
Magnesia	43.37	40.07	41.50
Ferrous Oxide	.87	2.41	2.81
Alumina	2.27	3.67	0.90
Water	13.72	14.48	13.55
Totals	100.53	99.68	99.63

Mineralogically and genetically we distinguish two particular groups or forms of asbestos:

1. Hornblende asbestos.
2. Serpentine asbestos (of the mines).

The first form is so called because it forms one of the varieties of hornblende in the amphibole series. Among the latter may be mentioned actinolite (radiated) and tremolite, which are also known as amianthus or hypsolite when of fine fibrous structure. The color of amphibole asbestos varies greatly, but the more common is whitish-gray or green.

Especially during the period 1897-1900 has the great distribution of this mineral over the whole surface of the earth been established. In consequence of the high value of commercial asbestos it has been prospected all over the world. Although reports of finds have come from many quarters, yet very few have proved profitable for mining. When a find was reported it was generally found to be amphibole asbestos, which is materially inferior in quality to the serpentine variety. The difference between the two is that the former is less fine and less flexible, besides lacking that silky lustre.

The species of the second group is a variety of serpentine, the latter a mineral of great geological interest. This asbestos goes under various names: chrysotile, mineral flax; liquiformed asbestos; mountain leather; mountain cork; etc. With the exception of the first, the rest have all a yellowish-brownish appearance, and occur frequently in fissures or small seams (Canada, Norway, Germany). They are seldom available in industry.

Technically, chrysotile takes the first rank of the varieties of asbestos mentioned. Under the name chrysotile is designated that variety of serpentine asbestos, in which the fibrous structure is arranged in fine parallel threads of silky lustre. It is generally of a greenish color, although grey or yellow is found. The principal deposits are in Canada, in the Province of Quebec, where enormous deposits are found, which during the past twenty years have developed into an active mining industry.

Although many attempts have been made in many countries to supplant the Canadian article, yet up to the present they have not succeeded. The Italian, Russian, and American (U.S.) varieties cannot compete with the Canadian, as they lack fineness and toughness of the fibre. The greater length of the Italian fibre is not of much account when compared with the Canadian, as the latter, when only half an inch in length, can readily be spun. Furthermore, in the spun thread, the strength of the thread when composed of fibre over three inches in length, is no longer directly proportional to the length of the fibre.

Asbestos is found in the United States in Vermont, Pennsylvania, Georgia, and California. The latest discoveries in the Green mountains in Vermont look very promising, and it is expected that the veins will increase in size as the work progresses.

The total production in 1900 of asbestos was as follows:—

	TONS.
Canada	30,641
United States	1,054
Italy and Russia	1,500
Total	33,195

For 1901 we have—

Canada	38,500
United States	1,300
Italy and Russia	2,000
Total	41,800

Although the production of Canada has enormously increased, yet prices have been well maintained, and this serves as a guarantee for the steadily growing demand for asbestos.

The following table will be undoubtedly of general interest, showing the annual production in Canada and the United States of this mineral.

Year.	CANADA.		U. S.		Year.	CANADA.		U. S.	
	Quantity. Short Tons.	Value. $	Quantity Short Tons	Value $		Quantity. Short Tons.	Value. $	Quantity. Short Tons	Value $
1879	300	19500	....	....	1891	9279	999978	66	3960
1880	380	24700	150	4312	1892	6042	388462	104	6416
1881	540	35100	200	7000	1893	6473	313806	50	2500
1882	810	52650	1200	36000	1894	7630	420825	325	4463
1883	955	68750	1000	30000	1895	8756	368175	795	13525
1884	1141	75079	1000	30000	1896	12250	429856	504	6100
1885	2240	142441	300	9000	1897	30442	445368	580	6450
1886	3458	206251	200	6000	1898	23785	486227	605	10300
1887	4619	226976	150	4500	1899	25536	485649	681	11740
1888	4404	255007	100	3000	1900	30641	763431	1054	16310
1889	6113	426554	30	1800	1901	38500	962500	1300	20150
1890	9860	1260240	71	4560					

(From U.S. Geol. Survey: "Production of Asbestos in 1900," by J. Pratt.)

To give an idea of the important place asbestos takes in the mineral products of the Province of Quebec in the year 1900, the following table is given :—

KIND OF ORE.	Number of Workmen.	Quantities Produced, Shipped, or Utilised.	Gross Value of Ore Shipped or Utilised.
Magnetic Iron Ore (long tons)	10	1550	3875
Bog Iron Ore	120	17186	34372
Calcined Ochre (tons of 2000 lbs)	52	1182	9300
Chromic Iron (long tons)	130	2068	83449
Low grade Copper (long tons)	270	33742	150152
Galena (long tons)	24	286	87381
Asbestos (tons of 2000 lbs)	1040	21408	719416
Asbestic ditto	....	7935	15948
Graphite, prepared ditto	....	13	2500
Graphite, raw ditto	25	388	6964
Phosphate ditto	....	1370	8900
Mica, thumb-trimmed ditto	500	335	138600
Mica, not prepared ditto	....	150	25000
Feldspar ditto	....	147	441
Sulphate of baryta ditto	8	460	3220
Slate ditto	60	915	10131
Flag stone (square yards)	9	4000	3500
Cement (barrels)	40	22100	36570
Granite	170	.....	65000

(From Report Department of Colonization and Mines: "Mining Operations in the Province of Quebec," by J. Obalski, M.E.)

The principal localities in the Province of Quebec where asbestos is mined are Black Lake and Thetford, lying about midway between Quebec and Sherbrooke, on the Quebec Central Railway.

The asbestos is here found in narrow fissures, one to one and a half inches in width (maximum five inches) of the belt of serpentine; and the fibres are generally perpendicular to the walls of the seam. Although the veins seem to run in all directions, yet on closer examination a certain order is discernible. Foremost among the latter is the grouping of the fissures in long-drawn zones, which again may include narrower and richer ones. It does not always follow that by penetrating deeper the veins enlarge, in fact, the reverse is often the case.

As long as the genesis of asbestos is not thoroughly understood, we shall not be able to set up definite rules and methods, as obtains in the mining of ore and coal, to assist in the opening and development of asbestos mines. I surmise that the formation of asbestos from the serpentine magma was materially influenced by granitic eruptions.

The frequent occurrence of fissures, running in all directions, in the serpentine gives evidence that the area must have been subjected to intense disturbances after the cooling or solidification of the serpentine. The effect of these disturbances causes the greatest difficulties in the development of an asbestos area.

The mining of asbestos is carried on by quarrying. As the fissures or seams are small it naturally follows that a great deal of dead matter has to be moved. The serpentine carries on the average from three to four per cent of asbestos, and rarely does it reach as high as six per cent. Dynamite is used as the explosive, and is put into 10 to 12 feet deep drill holes. In out-of-the way places the hand drill is still used, otherwise steam or compressed air is utilized. The broken rock is reduced to smaller pieces by means of heavy sledges and steel wedges, and then smaller hammers are used for separating the asbestos from the gangue. The latter work is done either in the quarry, or under cover when a purer asbestos is desired. For this work boys from 14 to 16 years of age are employed. As magnetic iron ore is sometimes found in the asbestos, particular attention must be paid that the fibres are not unnecessarily damaged in separating the mineral. This treatment furnishes what is known as "crude" asbestos, which is then ready for shipment, in bags of 100 lbs. There are two grades—Crude No. 1 and Crude No. 2.

On account of the relatively small percentage of asbestos in the rock blasted, it is necessary to have special appliances for moving the latter. For the smaller mines the ordinary crane answers, but for the larger ones the crane is supplemented by cables. In the latter case the cable is put at an angle of not less than 30 degrees, so as to utilise gravity in returning the pit-boxes to work.

It is evident that by either of the above two methods the area that can be served is very limited, and this has led to the introduction of cable derricks with tail-rope. In applying the latter means a cable, one and a half inches in diameter, is stretched across two masts, from 30 to 60 feet high. One end of the cable is fastened to some high point in the quarry, while the other end is fastened on the other side of the mast, and distant as far as possible from the foot of the mast. By means of the endless cable the engineer is enabled to lower the pit-box quickly, and to hold it at any desired point. The hoisting cable (¾ inch) brings up the load. The pit-boxes are shallow wooden boxes lined with sheet iron, and carry from 1 to 1½ tons After being hoisted to the surface they are either loaded directly on to waggon frames or are dumped into larger dumping cars, and then moved by horse or steam power. For hoisting, twin steam engines of from 15 to 20 horse-power are used.

After having given a general description of the mining operation, a few words may be added about the treatment of the less valuable asbestos. This latter consists of waste (mostly serpentine) from the crude asbestos, and of larger pieces of serpentine traversed by small veins of asbestos, which, however, it would not pay to treat, as heretofore described, by hand.

The extraction of the fibre from this inferior material is done by machinery in asbestos mills. The broken material, or at least the smaller pieces, is first subjected to a drying process in rotating cylinders; it then passes through stone crushers and rollers, whereby it is reduced to a given fineness, when it passes into the "cyclones," where further reduction takes place, especially the disintegration or separation

of the individual fibres. This process (centrifugal) continues until the rock is ground to sand and the asbestos fibres are thrown on to the separating sieves. From the latter the fibers are drawn away by exhausts, and the sand is blown into bins. Nothing remains now to be done but to fill this asbestos, known as "paper stock," into bags of 100–150 pounds for shipment. According to quality it is designated as Nos. 1, 2, or 3.

It is probably scarcely necessary to state that the above description is but very brief, and the actual work is not at all so simple, but we cannot here enter into greater detail.

As already stated, asbestos commands a good price, and higher than ever, although the production has greatly increased.

"Crude" asbestos, No. 1 sells from $150 to $250, and No. 2 from $80 to $150 per ton; paperstock runs from $20 to $40 per ton. To explain the difference between the above prices it is necessary to state that in the different mines for a given class different prices obtain, depending upon the length of the fibre, and upon the per cent. of impurities.

Beside the mines of Black Lake and Thetford, those at Broughton and Danville deserve mention.

Although asbestos occurs near Ottawa, yet it is in too limited quantity, the veins being small in number, to be of any commercial importance. The fibre is very pretty, and of a light yellow-green color, the same as the serpentine.

So far as known there are no other localities in Canada where asbestos could be profitably mined. At the present time there are in Canada twelve asbestos mining companies, with a capital of four millions; the mines requiring at present about 3000 men. Difficulty is experienced, especially during the summer months, in obtaining sufficient labor, and efforts are made to obtain the requisite supply. The wages, for 10-hour shift, are from $1.25 to $1.50, which is considered fair pay, considering that the cost of living in the Province of Quebec is relatively low.

From the foregoing the importance to Canada of the industry of asbestos mining must be apparent. In this she rules the markets of the world, and to all appearances will continue to do so on account of the extensive area of her asbestos deposits and of their high quality.

We may safely say that, with the very good prices prevailing, and the rapidly increasing demand, asbestos mining in Canada has a decidedly bright future in store.

Notes on Oil Furnaces for Assaying and Melting.

By Charles Brent, M.E., Rat Portage.

In view of the fact that the use of oil fuel in many departments of metallurgy has been greatly extended during the past two years, a few practical notes on the use of oil as applied to the furnaces necessary in the assay office and melting room may be found of interest to some of the members of the Institute.

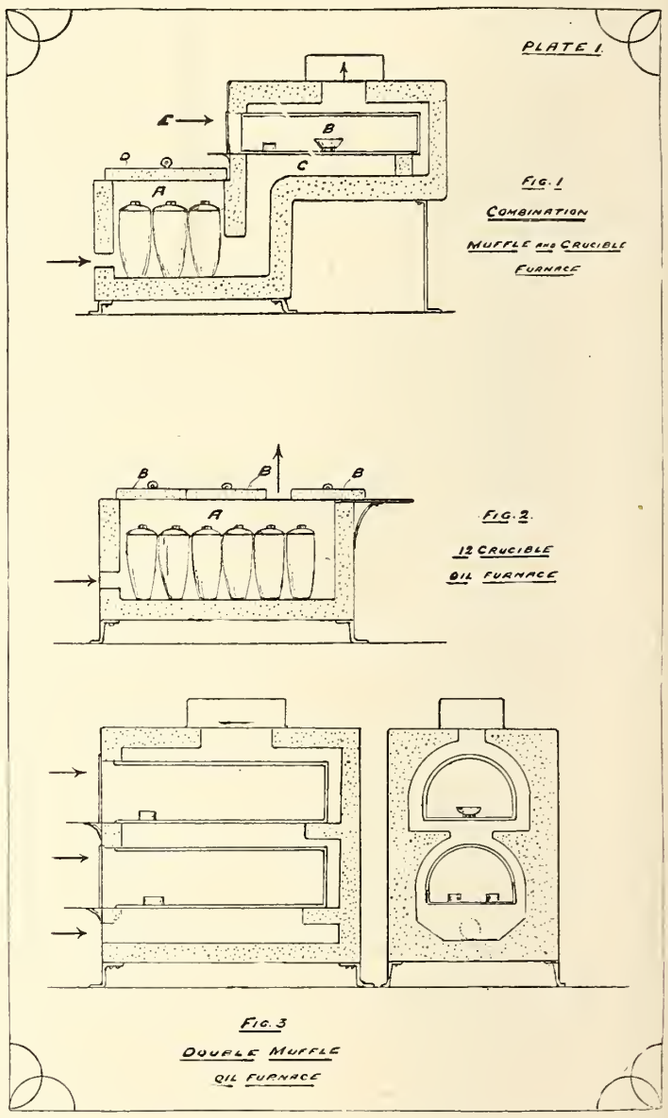
The furnaces described in this paper were designed by the writer mostly for use in my own laboratory and are the result of a good deal of practical experiment in the use of oil for fuel, carried on for the past twelve years. Petroleum, either as gasoline, refined oil or fuel oil, can be used in any of the furnaces and it will be found to possess many advantages over any other class of fuel wherever steam or compressed air can be obtained, or even the comparatively light pressures from an ordinary blower. It will be found in most cases more economical than either charcoal, coke, coal or gas, and wherever ordinary precaution is used the risk from fire or explosion will be reduced to the vanishing point.

The saving of time and labor in the use of oil fuel as compared with solid fuel must be known to be properly appreciated, and the ease of manipulation and the freedom from dust and ashes and outside heat will recommend this fuel very strongly to anyone who tries it.

The furnaces described and illustrated in this paper can be constructed by any ordinary mechanic, and will cost less than half the money ordinarily expended for furnaces of like capacity for solid fuel.

They occupy a quarter of the space usually taken up by furnaces of the old type, and can be placed in any convenient part of the laboratory to which air or steam and oil can be piped.

The construction of all the furnaces is the same in that they are all constructed of sheet steel, of suitable weight, according to the size of the furnace. The shells are lined with a plastic mass, composed of 4 parts of old assay crucibles ground to about 20 mesh and 1 part of good finely-ground fireclay. This mixture should be worked up with a



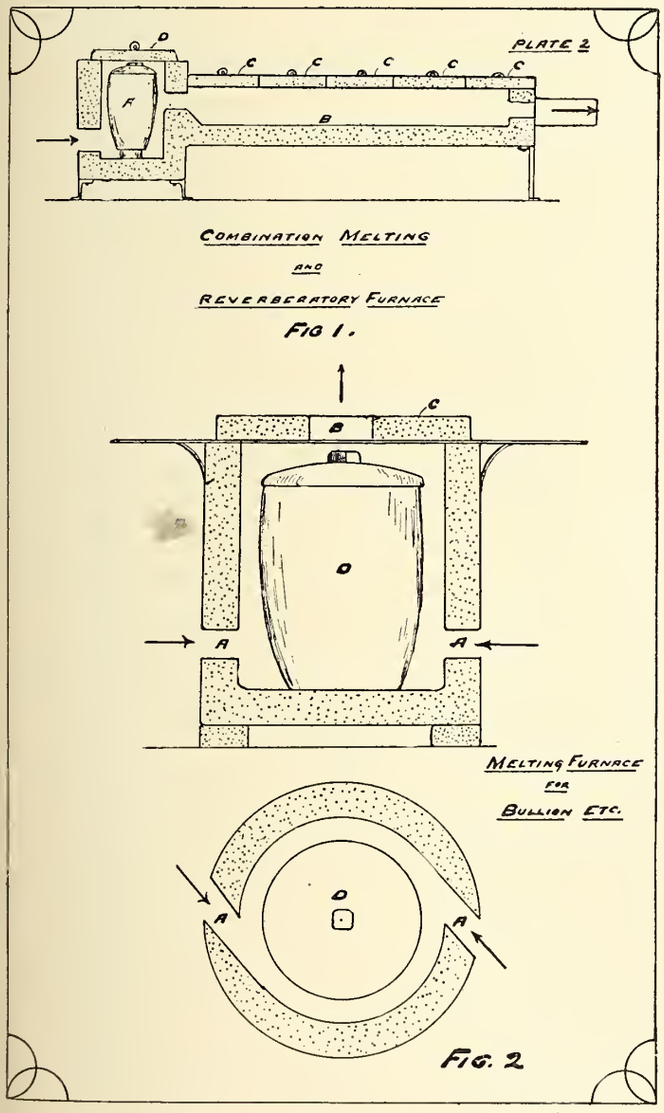
small quantity of water and put in as stiff as it can be handled. After a day or two drying, a light wood fire is put in the furnace until the lining is thoroughly hard.

A little caution must be used the first time oil fuel is applied, but if the furnace is thoroughly dried the heat may be pushed at once to the extreme limit required.

On cooling, the lining will be found pitted together by the small quantity of slag from the broken crucibles and will usually be free from cracks. Should any develop they should be filled with a thin mixture of the lining material. This lining burns as hard as porcelain, and as there are no ashes from solid fuel to slag the walls, it will be found practically indestructible. (The writer has a small furnace in his laboratory in which thousands of assays have been made, and the lining is today as good as the day it was first put in.)

The combination furnace shown in Fig. 1, Plate I, was designed to hold six Battersea crucibles, size E or F, and a size J or H Battersea muffle. In the diagram A is the crucible chamber with an opening below and in front to admit the jet of oil and steam or air. A convenient cover for the chamber is an ordinary soapstone foot-warmer, bored and fitted with an iron ring for convenience of handling Behind and above the crucible chamber is the muffle chamber, C, containing the muffle B. The walls of this chamber hug the muffle at the sides, the top and the end within ¾ of an inch and the opening for the escape of the products of combustion is placed in the middle of the muffle. A small door lined with a sheet of asbestos closes the opening to the muffle and a small shelf beneath this adds to the convenient working of the furnace.

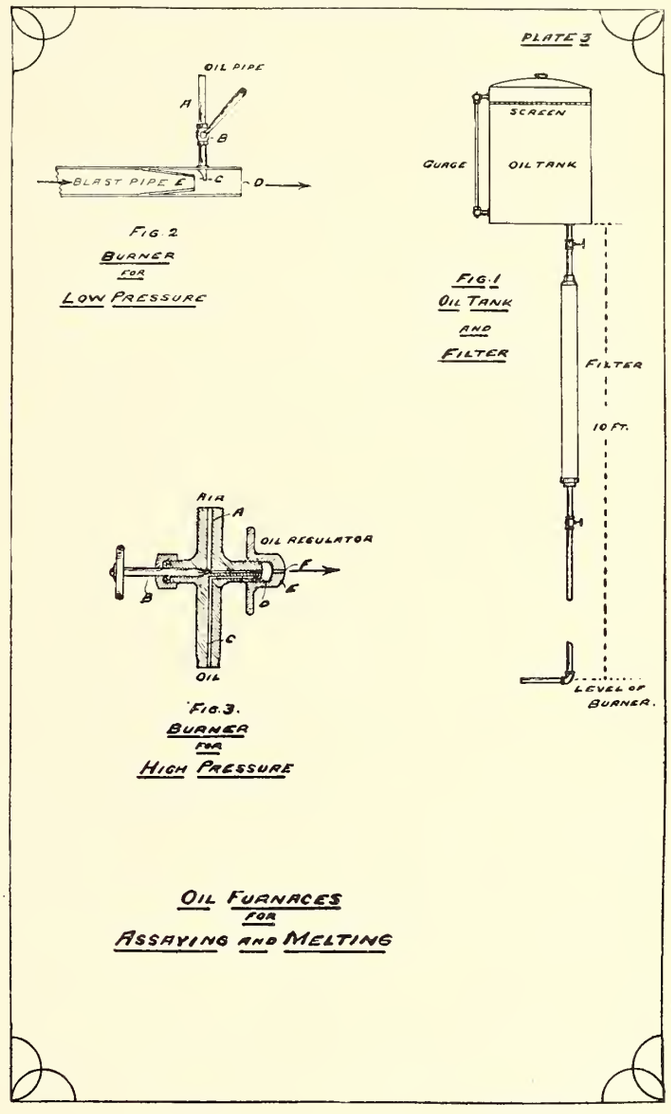
This furnace can, with the right quantity of oil and air at 80 lbs. pressure, be raised to the temperature for fusion for assays in less than ten minutes, and the muffle will be found at a suitable temperature for cupellation in fifteen minutes. Work can be carried on simultaneously in both crucible chamber and muffle, as the jet sweeps between the crucibles and strikes at once into the muffle chamber. This furnace will make a set of fusions in 20 minutes, and by the use of a second jet of compressed air, E, into the mouth of the muffle a set of cupellations



on 10 gramme buttons can be made in from 7 to 10 minutes. The fuel burned will be less than three-quarters of a gallon of oil, which, after the furnace has been burning a few minutes, can be cut down to burn with a practically invisible flame. The saving in crucibles and muffles in this furnace over a furnace of similar capacity for solid fuel, will be found a very strong point in its favor. (The writer has in use in his laboratory a muffle that has been heated at least five hundred times, and it is as good as new.)

The furnaces designated as Figs. 2 and 3 (Plate I) were designed to be worked together in an assay office handling ordinarily one hundred assays and upwards per day.

Fig. 2 is a crucible furnace designed to take in 12 size E or F crucibles in the chamber H, which is covered with three soapstone covers, B. The jet is admitted through an opening at the bottom and in front and the products of combustion escape through openings be-



tween the covers B, which are arranged to slide apart for this purpose. The regulation of the fusions is perfect. If it is desired to hasten up the melting of the back set of crucibles, an opening is left over them by sliding the covers apart.

A suitable sheet iron hood about 3 feet above the furnace is connected with the chimney and serves to carry off all fumes, without interfering with the work at the furnace. This furnace will burn a gallon of oil every hour and will turn out a batch of fusions every 25 minutes.

Fig. 3.—This is a double muffle furnace designed to hold two size K muffles, and the regulation of the heat in the two muffles is accomplished by the proper combination of the jet below and the draft above. Ordinarily the bottom muffle will become much hotter than the upper one, but on increasing the air in the jet below and opening the draft above, the two muffles can be regulated to the same temperature. The furnace will burn from ¾ of a gallon to 1 gallon per hour of oil, will be hot enough for cupellation in either muffle in 20 minutes and hot enough

for scorification in 25 minutes. An obvious saving in fuel is made in furnaces of this size as, in the oil furnace, the moment the work is done, the oil is turned off and there is no further consumption of fuel, while in a furnace for coal or coke, from half a bushel to a bushel of incandescent fuel is ordinarily left to burn to waste in the furnace after the work is done.

The furnace designated as Fig. 1, Plate II, was designed for drying and washing the gold precipitate from the chlorination process and melting the dried product.

The precipitate is dried and washed in a series of trays on the hearth B of the furnace, any part of which is accessible by sliding the covers, C. After drying and washing the product is transferred while hot to the plumbago pot, A, which has during the washing attained a full melting heat. Any fume or dust is retained in an enlarged section of the shaft pipe which can be opened and cleaned at suitable intervals.

Fig. 2, Plate II, shows a double jet furnace, designed for melting bullion.

The jets form a tangent to the surface of the melting pot and form a whirling flame between the pot and the furnace walls, the products of combustion escaping through a hole in the centre of the furnace cover. This furnace will be found extremely rapid and convenient to use, especially on bullion which requires a good deal of slagging and refining. Any melter who has stood over an ordinary coke furnace for an hour filled with incandescent fuel, will appreciate a melting furnace that at a touch can be so cooled off as to be worked over with no discomfort from either light or heat. The furnace can be placed anywhere in the melting room, requires no expensive smoke stack, and takes up but little room. The furnace itself is ordinarily only 4 inches more in diameter than the crucible it holds, and is only about 4 inches higher. The rapidity of melting must be also taken into consideration. The writer has melted a thousand ounces of retort sponge and slagged it thoroughly clean in less than an hour with the consumption of 1¼ gallons of fuel oil, and has repeatedly melted twenty pounds of brass in less than half an hour with less than half a gallon of fuel.

A great many modifications of these furnaces will suggest themselves to the members of the Institute; but anyone who once tries oil fuel in any of the various furnaces required about an assay office or melting room will afterwards "use no other."

Fig. 1, Plate III, shows an oil reservoir with screen near the top and gauge glass on the side and connected below to a filter, which is simply an enlarged section of the supply pipe filled with coarse clean sand. It will be found a very important matter to free the oil from every trace of suspended matter, especially when using the high pressure jets, as the openings are so minute that a very small particle of grit will stop the flow of the oil. It will be found convenient to locate the oil reservoir at least 10 feet above the jets to keep a proper head of oil on the burners.

Fig. 2, Plate III, roughly illustrates the form of burner used by the writer with an ordinary pressure blower giving a pressure of 6 to 10 inches. The oil comes to the blast pipe through pipe A, its flow being regulated by stop cock B. The blast pipe is contracted to a nozzle E, and the end of the pipe C is flattened as shown in diagram.

Fig. 3, Plate III, shows the ordinary high pressure burner which can be bought now from a number of firms manufacturing oil-burning furnaces for steam-raising and forge work.

The air enters through a passage H, its blow being regulated by needle B. It issues through the central orifice F, and sprays the oil entering through a passage C. The flow of the oil is regulated by the cap E, which when screwed up completely closes the opening D of the passage C, without interfering with the passage of the air.

The Ore Deposits of the Boundary (Creek) District, B C.

By R. W. Brock, B.A., Ottawa.

The district treated of in this paper is that lying along the International Boundary line, in the neighborhood of and between the valleys of the north fork of the Kettle river and Boundary Creek, B.C. Following upon the construction of the Columbia and Western railway, a little over two years ago, and the installation of smelters at Greenwood and Grand Forks a year and a half ago, the district at once took a foremost place in British Columbia lode mining and it now ranks as one of the most important factors in the production of copper in Canada.

While the mountains are not rugged and the western and southern slopes are often open, prospecting has not been easy, on account of the covering of drift which conceals the rocks over a considerable portion of the surface and on account of the complex geological structure of the district.

* Eruptive rocks, including granites, greenstones, lavas (and associated tuffs) and various intrusive dykes have the widest distribution. More or less altered sedimentary rocks (limestones, argillites, quartzites) together with more highly altered metamorphosed rocks, including serpentine, are met with in all parts of the district, but do not, as a rule, have large dimensions in any one place, being usually nothing more than inclusions of older formations caught up in the intrusive rocks.

The oldest rocks recognized in the district are the sedimentary and crystalline rocks. In the south-eastern part of the district just west of Grand Forks, some crystalline mica and hornblende schists and crystalline limestone occur, which resemble lithologically the rocks of the Shuswap series (Archean), but they may possibly merely represent in a more highly metamorphosed form the argillites and limestones found elsewhere in the district.

The argillites are normally dark or red, occasionally highly carbonaceous, but are often altered to gray knotted schist, or hornfels. or they may be largely silicified. The limestones are usually white and crystalline, but occasionally show an original black color. In places the lime is replaced by silica, forming cherty or quartz-like jasperoid rocks. True quartzite is only sparingly found. Closely associated with these is a serpentine, probably derived from a basic eruptive rock. It is frequently altered to a siliceous dolomite or magnesite. These rocks form a series closely resembling, and probably of the same age as, the Cache creek series described by Dr. Dawson, and ascribed by him to the carboniferous formation.

Somewhat younger than the sedimentary rocks is the greenstone, which has the greatest areal distribution of all the rocks of the district. Often it is altered, but where its structure is preserved it appears to be an augite-porphyrite, sometimes agglomeratic, similar to that rock found in many parts of West Kootenay, notably around Rossland. It cuts and holds inclusions of the older rocks. Indeed, in most of their occurrences, the latter appear simply as islands in the greenstone, varying in size from small fragments, closely packed and almost filling the greenstone matrix, to bands hundreds of meters long. Under pressure it becomes schistose and difficult to detect from some of the included argillites. Occurring with it are bands of tuff, filled with fragments of the older rocks, and interbanded with fine-grained ash-beds.

Younger than and cutting the greenstone is a gray hornblende-biotite granite which is exposed near Greenwood, in Wellington camp, and on Hardy mountain. Gray granite porphyry dykes from it cut the older formations a long way from the parent masses. The white altered porphyry on McCarren creek and at the City of Paris mine, may belong to this series of dykes. This granite will probably prove

* The rocks have not been studied microscopically, and cannot therefore be named with strict scientific accuracy, but still closely enough for most practical purposes.

ASBESTOS MINING IN QUEBEC.

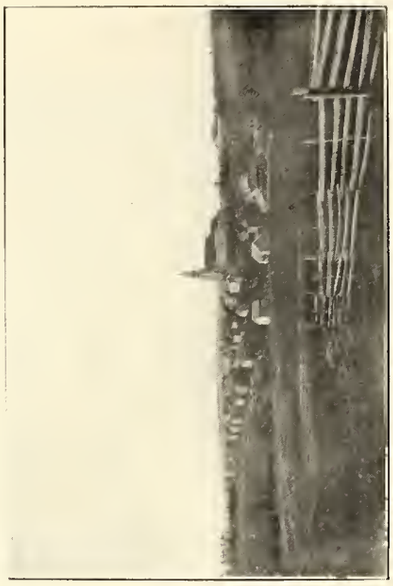


An interior view of the Main Pit of the Bell's Asbestos Co., Thetford Mines, Que.

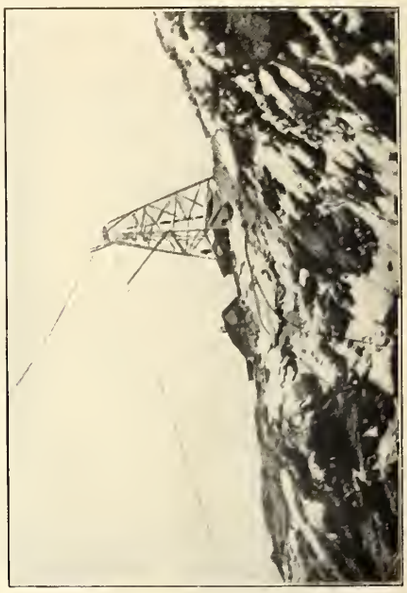
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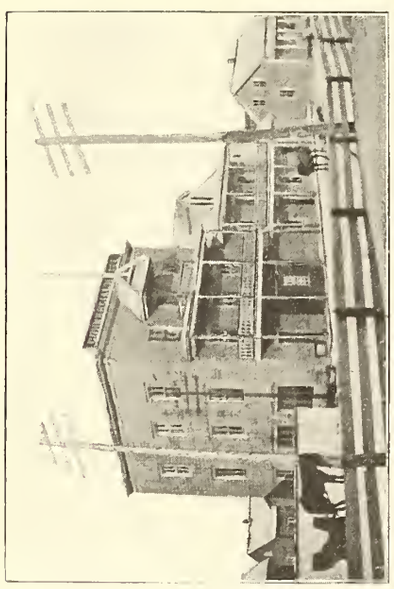
Black Lake, Que.



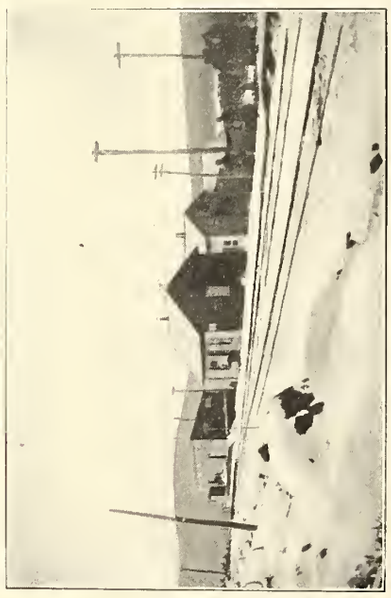
Village of Black Lake, Que.



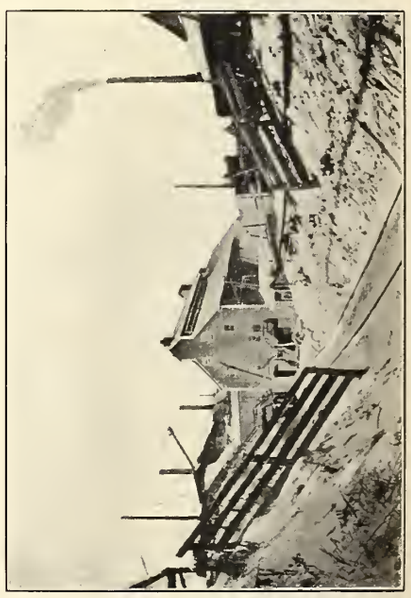
Manhattan Asbestos Co., Black Lake.



Commercial Hotel, Thetford.



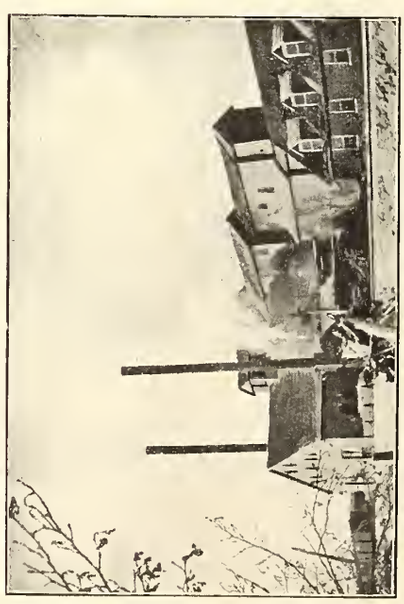
Black Lake Station, Q. C.R.



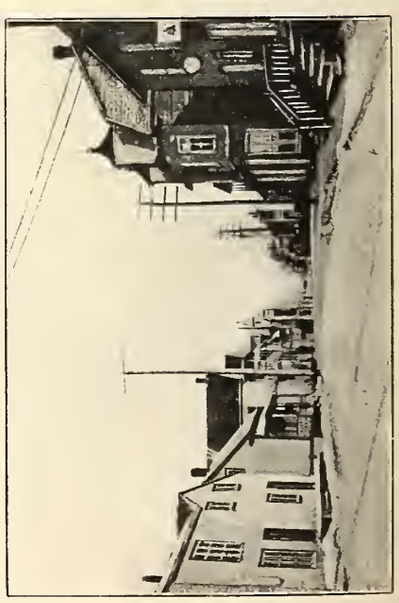
Bell's Asbestos Co., Thetford.



Johnson's Company, Thetford.



Asbestos Mills at Thetford, Que.



Main Street, Thetford Mines.



Union Asbestos Co., Black Lake.



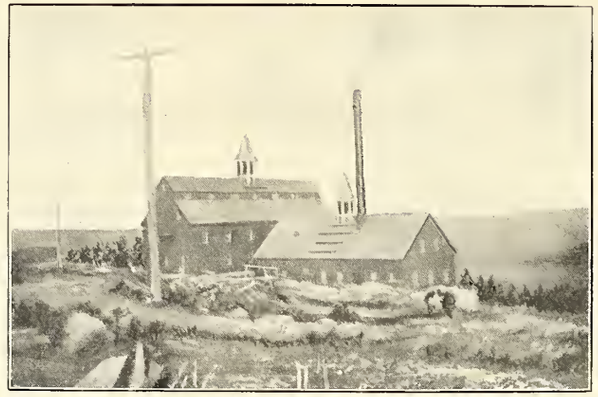
Black Lake, Que.



Johnson's Co., Black Lake.



King Bros ' Mill at Thetford.



Johnson's Co., Black Lake.



Standard Asbestos Co., Black Lake.



Hotel, Black Lake, Que.



Drilling for Asbestos.



ASBESTOS MINING IN QUEBEC.

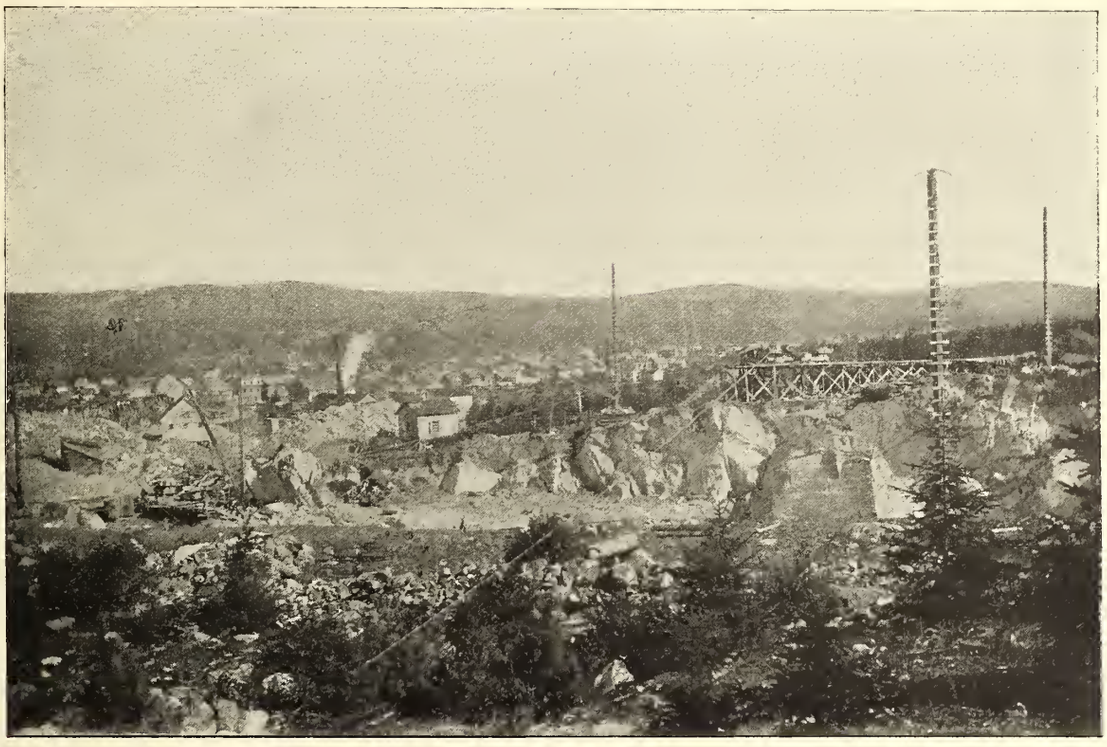


Asbestos Milling Plant of the Bell's Asbestos Co. at Thetford Mines, Que.



Interior of one of the great Asbestos Quarries worked by King Bros. at Thetford Mines, Que.

ASBESTOS MINING IN QUEBEC.



General View of Thetford Mines, Que.



Interior of Big Pit—King Bros. Asbestos Mines, Thetford, Que.

ASBESTOS MINING IN QUEBEC.



Cable Derricks and Surface Plant at Danville, Que., operated by the Asbestos and Asbestic Co. Ltd.



Interior of Pit, Danville, Que.

ASBESTOS MINING IN QUEBEC.



Asbestos Mining at Black Lake, Que.



Another view of the Quarry of the Asbestos and Asbestic Company at Danville, Que.

ASBESTOS MINING IN QUEBEC.



Unique type of Mine Locomotive in service at the Bell's Quarries, Thetford Mines, Que.



Locomotive "Tos and Tic" in service at the Pits of the Asbestos and Asbestic Co., Danville, Que.

ASBESTOS MINING IN QUEBEC.



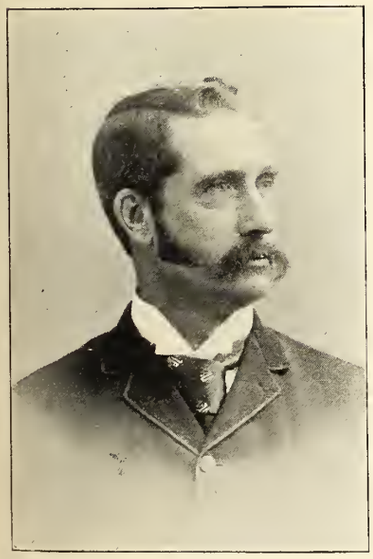
B. BENNETT,
Manager, King Bros.,
Thetford.



T. H. CRABTREE,
Manager, Union Asbestos Mines,
Black Lake.



HARRY J. WILLIAMS,
Manager, Beaver Asbestos Co.,
Thetford Mines.



R. T. HOPPER,
Standard Asbestos Co.,
Black Lake.

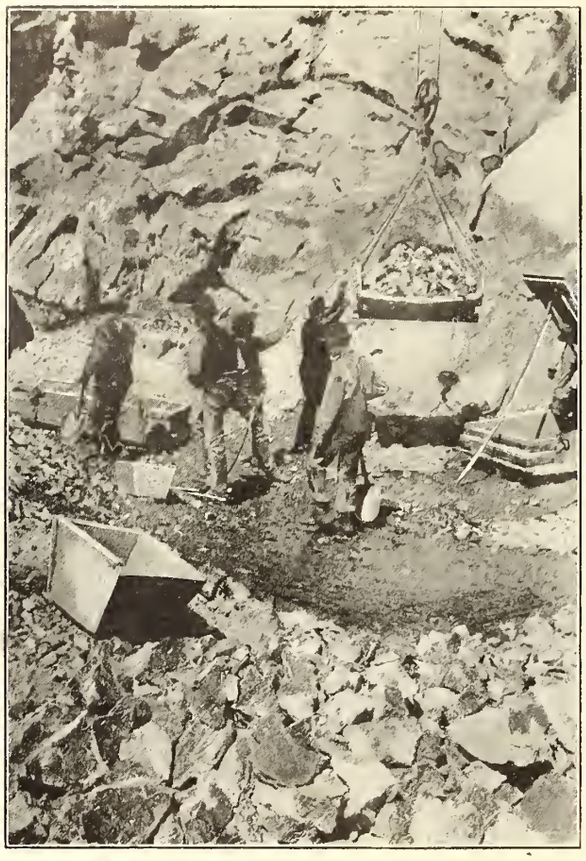


GEORGE R. SMITH, M.L.A.,
General Manager, Bell's Asbestos Co.,
Thetford Mines.



WM. SCLATER,
Canadian Asbestos Co.,
Black Lake.

ASBESTOS MINING IN QUEBEC.





Asbestos Mining and Milling at Black Lake, Que.



Bell's Asbestos Co.—New Double Track Trestle over road and Q C.R from dump.



View taken on curve of the Quebec Central Railway at Thetford Mines, showing large new asbestos mill of the Beaver Co. in the background.



An interior view of the Main Pit of the Bell's Asbestos Co. at Thetford Mines, Que

ASBESTOS MINING IN QUEBEC.

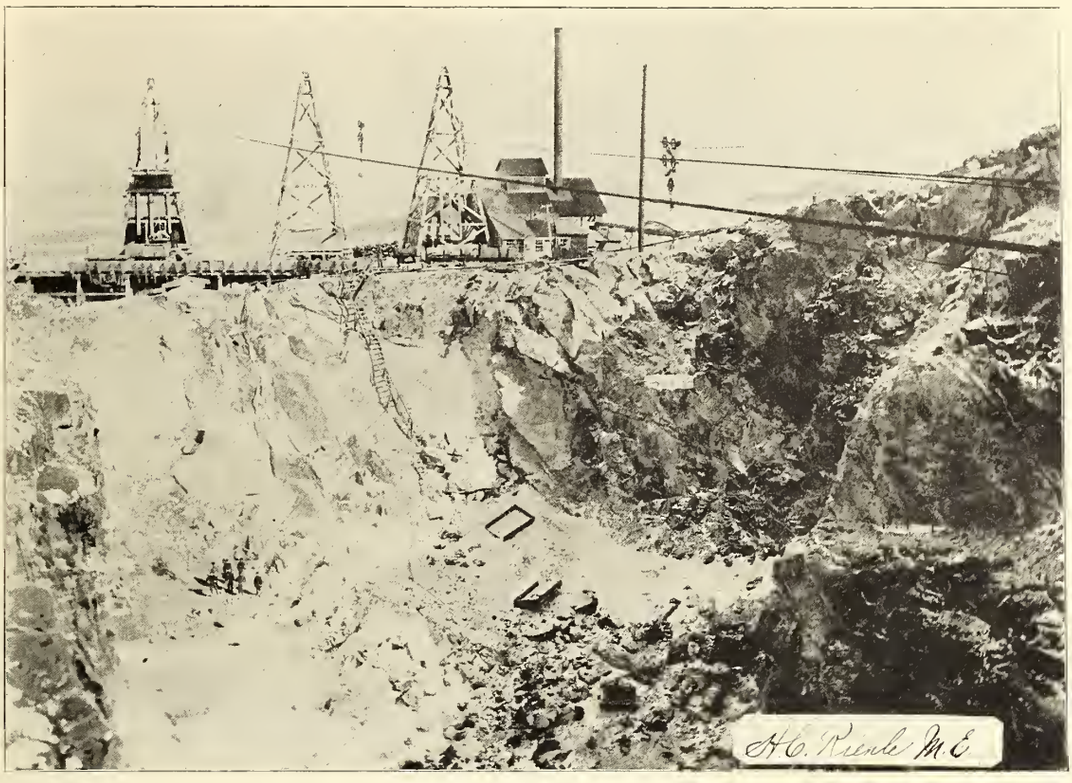


Asbestos Milling Plant at the Union Mine, Black Lake, Que.



Another view of the Pits of the Union Asbestos Mine at Black Lake, Que.

ASBESTOS MINING IN QUEBEC.



Cable Derrick Plant at the Union Mines, Black Lake.



At Union Asbestos Pit, Black Lake, Que.

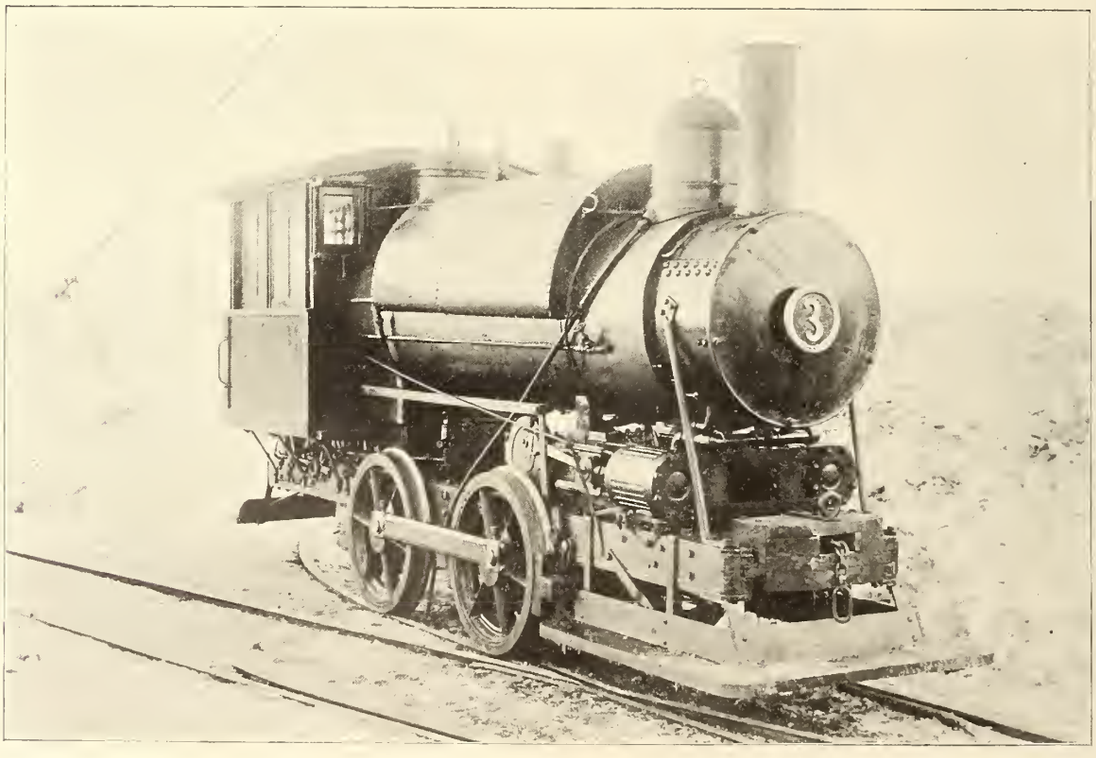


Union Asbestos Mill, Black Lake, Que.

ASBESTOS MINING IN QUEBEC.

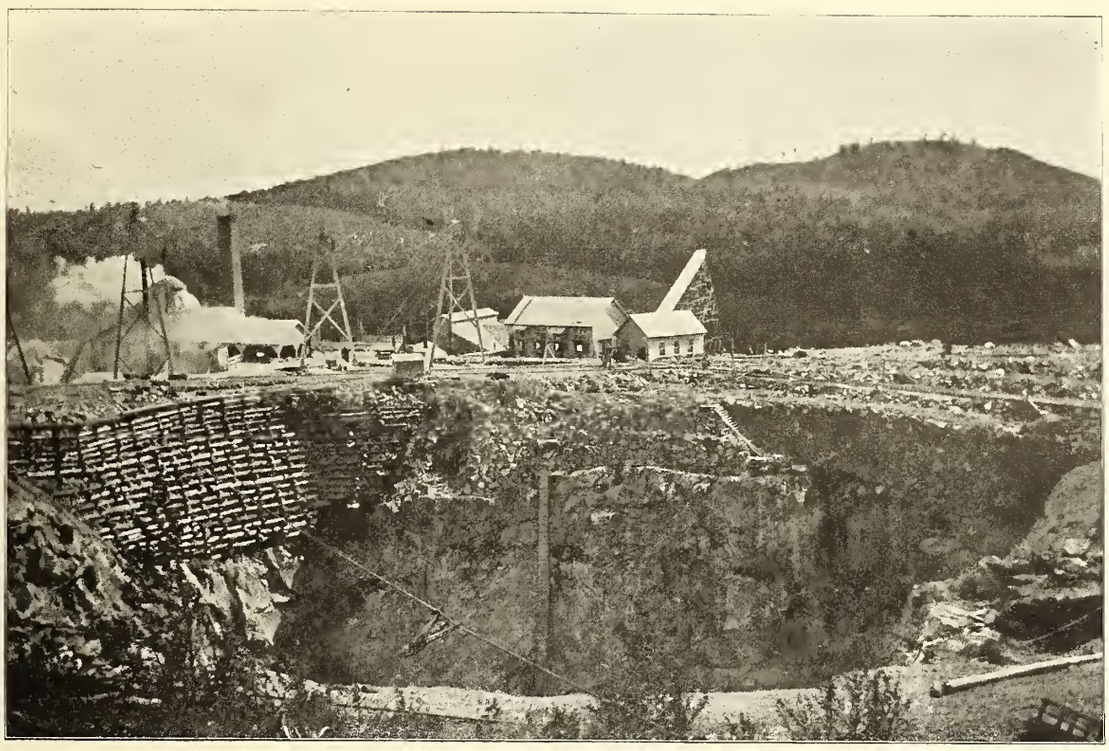


Milling Plant at Thetford Mines, Que., showing extensions added recently by the Bell's Asbestos Co.



Locomotive No. 3 of the Bell's Asbestos Co.—This type of engine originally designed and constructed by Mr. George Smith, of the Bell's Company, is now generally adopted at the asbestos mines, its manufacture being one of the features of the shops of the Jenckes Machine Co. at Sherbrooke.

ASBESTOS MINING IN QUEBEC.



View of Main Open Cast Workings of the Asbestos and Asbestic Co. Ltd., at Danville, Que.



Milling Plant of the Asbestos and Asbestic Co. Ltd., at Danville, Que.

ASBESTOS MINING IN QUEBEC.



Large New Asbestos Mill erected by the Beaver Asbestos Co. at Thetford Mines, Que.



Milling Plant of the Standard Asbestos Co. at Black Lake, Que.

to be the same rock as the Nelson granite, of West Kootenay, and about Jurassic in age.

Near Central Camp and northwest of it are bosses and dykes of a gray diorite porphyrite, which microscopically closely resembles the Rossland monzonite, but until it has been carefully studied it is still uncertain that it is the same rock. Younger granites occur just outside the area described.

Beds of volcanic rocks are found at several points overlying the rocks already referred to. These are remnants of a sheet of volcanics which once covered the entire country but which, in this district, have been largely removed by erosion. The series consists of coarse and fine tuffs, ash-beds and shales (in which coal is sometimes found) with sheets of andesites, basalts, and other volcanic rocks. These latter are sometimes locally termed "bird's-eye porphyry." This series is probably of Tertiary age.

Dykes of a reddish or yellowish syenite-porphyry, having a fine-grained ground-mass, with conspicuous rosette-like phenocrysts of feldspar and some biotite, are common in the mineralized portions of the district, though wanting in the unmineralized. On the Carbonates claim, this reddish porphyry is seen as a contact facies of a coarse syenite-porphyry similar to those observed east of the North Fork and in the Rossland district, where such dykes are known to be from the Rossland granite. They would appear to have the same relationship here, but it is yet to be proved that they have no genetic connection with the volcanic flows as well. Dark lamprophyric dykes and some of a brownish basalt-like rock also occur.

The ore-bodies may for convenience be roughly divided into three classes: (1) The large low-grade copper-bearing sulphide deposits; (2) the oxydized copper veins, and (3) the small gold and silver-bearing quartz veins.

Undoubtedly the most striking characteristic of the deposits of the first class is their enormous size. In the Mother Lode mine development work so far has exposed an ore-body, for a length of 1180 feet, and a width of 140 feet, which is continuous to the bottom of the workings, at present 500 feet. The Knob Hill–Ironsides lead is of as yet unknown dimensions. It extends through the greater part of the length of both claims and probably into the Gray Eagle. The lowest stopes are 700 feet below the highest point of the vein, but diamond drilling has proven the vein for another 100 feet. Its proved width is said to be 400 feet. On the second level three ore shoots are said to occur, one of 150 feet, one of 100 feet, and a third of 200 feet in width. These with the poorly mineralized rock between, would give a total width to the vein at this point of approximately 800 feet. One stope, 100 by 200 feet, is all in ore. While these figures are only approximate, they serve to illustrate the great size of the ore bodies and the extent of mineralization. These are of course the largest ore bodies yet disclosed, but some of the less developed properties have also very large deposits.

In structure these deposits belong to composite-vein type, formed by mineralizing solutions traversing the country rock, principally along fissures or zones of fissures in which they deposit the economic minerals and from which they replace with their mineral contents, particle by particle, sometimes only partially, sometimes completely, the original material of the country rock. On the outskirts of an ore body this substitution may be seen in all stages of development, the individual constituents of the country rock being one by one replaced Sometimes, as on the Emma claim, the replacement of the country rock has gone on so evenly that a completely banded ore has resulted. A banded structure cannot here be taken as a proof of open filling.

According to the most prominent mineral content, this class of deposits may be subdivided into a pyritic type, in which pyrrhotite, chalcopyrite, with some pyrite, are the chief minerals, and a magnetitic type in which magnetite, chalcopyrite with some pyrite, are chief minerals. Excepting that the pyrrhotite of the one is represented by magnetite in the other, these two types appear to be identical. Both the magnetite and the pyrrhotite replace the constituents of the country rock in the same way, both seem to have been formed, on the whole, a little prior to the other vein minerals, holding them in little veins or as points scattered through, yet sometimes interbanded with them; they are both accompanied by the same accessory and gangue minerals and the country rocks show the same alterations in both cases. Rarely do both the pyrrhotite and magnetite occur in the same deposit. In the Mother Lode a very little pyrrhotite is however reported, and in one or two small veins, as on the O. P. and Wolverine claims, both are found. The B. C., Maple Leaf, Winnipeg, Lake and Morrison, may be mentioned as representatives of the pyritic type, while the Knob Hill–Ironsides, Mother Lode, Brooklyn, Snowshoe, Oro Denoro, Emma and R. Bell belong to the magnetitic type.

Besides the metallic minerals already mentioned some marcasite appears to occasionally be present, and sometimes arsenopyrite, galena, zinc-blende, and molybdenite, but these are in all cases subordinate in quantity. Tetrahedrite has been found on the City of Paris. Specular iron is found somewhat sparingly in the Knob Hill, Brooklyn, Stemwinder, Snowshoe, B.C., and other mines; and bismuthinite occurs on the Bluebell claim, Summit Camp.

Calcite is a common gangue mineral, sometimes well crystallized, forming large masses, and also in the form of little seams through the ore and country rock. Seldom is it found in large quantities in those parts of a vein in which magnetite is heavily concentrated. Quartz is also an abundant gangue-stone, occurring in the same way as the calcite, though I have not observed it well crystallized. Silicification of the country rock to a cherty or quartz-like (jasperoid) mass, is a common, though not invariable phenomenon in the neighborhood of a vein. Red and green garnet (probably grossularite and almandine) and epidote are very abundant in and near the veins, both well crystallized and massive, often interbanded with the ores and forming a very large percentage of the vein material. The progress of their formation may be observed at many points in all stages, not only when limestone, but also when greenstone and granite form the country rock. In the Mother Lode, where limestone seems to be the country rock, while these minerals are developed the chief mass of the altered rock is made up of a felt-like aggregate of short green fibres, apparently of actinolite. A beautiful white radial tremolite occurs in the limestone at the Morrison mine. Kaolin, chlorite, and serpentine are probably among the alteration products, but until the microscopic examination of the rocks has been made an accurate account of the secondary minerals and their relative importance cannot be given.

The ores occur in all rocks except the most recent, the latter being the youngest granites, the porphyry and basic dykes and the Tertiary volcanics. In age, then, these deposits are probably early Tertiary. So far as yet found mineralization is confined to districts which show evidences of recent disturbance, more particularly where the older rocks are cut by the recent intrusives. Limestone in such a district seems favorable for the deposition of ores. In some cases the ore occurs in the limestone itself, but more frequently it is found in a rock along its contact with limestone. Thus in a greenstone where it holds inclusions of limestone, the ore often occurs in the greenstone along its contact with the limestone, while the latter may show little or no mineralization. The lack of mineralization in the limestone in such cases may be due to the fact that the limestone often flows and forms compact lenticular masses, instead of fracturing, under pressure, and thus furnishes no channels for the mineralizing solutions. If attacked and replaced by them, it must have been along the contacts and this must have taken place comparatively evenly, leaving a clean-cut unmineralized wall. While this may have been the case in some of the larger deposits, in many of the smaller veins occurring along such contacts the mineralization shows a distinct preference for the greenstone, the

limestone remaining unmineralized. That the contacts between lime and other rocks should be favorable may have been due in part to the chemical influence of the lime in precipitating the mineral contents of the solutions, but it was also due to the lack of firm cementing between the limestone and the contact rock, which left free channels that the solutions used as highways and bases for their operations. But while such contacts are favorable, mineralization is by no means confined to them. In fact in tne largest deposit yet found in the district (Knob Hill–Ironsides), with the exception of an insignificant island of it, found on the intermediate level, limestone is conspicuously absent, although it occurs at numerous unmineralized points in the vicinity. While most of the deposits are in greenstone, limestone or contacts between these, they also occur in the serpentine, argillites and gray granite.

Porphyry dykes are usually to be found in close proximity to the ores, sometimes as at the No. 7 mine the ore lies parallel to a dyke along its contact or in the immediate neighborhood. At the B. C., Mother Lode and other mines dykes lie almost horizontal, running through the ore-bodies at approximately right angles. The ore is continuous on borh sides of the dykes, little or not at all faulted or otherwise altered by them. The dykes, while containing traces of metallic minerals, show no signs of mineralization. In age they are about the same or a little younger than the ore deposits, showing the deposits to have been formed during or before the close of the cooling of the eruptive magmas.

While the deposition of the mineral contents of the veins is evidently largely hydrothermal, many of the minerals formed are characteristic of contact zones and there seems to be strong reasons for supposing the deposits to be connected with eruptive after-actions. The reasons for this belief cannot be discussed at length in the limits of a short paper. The magnetite appears to have been formed in the same way and under the same conditions as the pyrrhotite. It appears to be a primary constituent of the ore. Its formation seems to have depended upon a deficiency in sulphur, the available sulphur being siezed upon by the copper and going to form chalcopyrite. On account of the variety of rocks in which the ores are found it is evident that the source of the material of the veins cannot have been local. From the fact that the mineralized districts are much cut up by eruptive dykes, that areas of recent eruptions are close at hand and vents from which the volcanic series was ejected are probably near by, and that magnetite has so far seldom or never been found to have resulted from the deposition of ordinary mineral-bearing underground solutions, while common in contact metamorphism and as the result of solfataric action, it seems fair to conclude that the deposits have a connection with the recent eruptive rocks and that at least some of the material was derived from the magma of the eruptives brought up by the after-actions characteristic of vulcanism. This view is supported by the independence of the deposits with regard to the country rocks, the resemblance of some of their materials to that of nickel-pyrrhotite and other deposits considered to be the products of magmatic secretion and others to the products of volcanic after-action. At the same time it is not claimed that deep-seated underground circulating waters have had no share in the mineralization. Indeed the mingling of solutions from the two sources may have had a marked infiuence in the precipitation of their mineral contents.

Somewhat similar deposits, though on a much smaller scale, of magnetite and chalcopyrite occur at * Cherry Bluff, Kamloops lake, near what Dr. Dawson considered a volcanic vent. These have no doubt been formed by volcanic after-actions.

† In the Kristiana district, Norway, magnetite and specular iron, together with the sulphides of copper, zinc, lead, etc., occur within the metamorphosed zone of eruptions, especially granite, though as far as 2 kilometers from the actual contact. In association with them are contact minerals similar to many in the Boundary District. These deposits are explained by Vogt and others as the result of contact metamorphism and after-actions.

Similarly the Norwegian pyrite deposits have been shown by the same authority to be connected with contact metamorphism due to gabbro and granite.

‡ The pyrrhotitic deposits of Rossland, B.C., have many points of resemblance to the Boundary deposits, although differing somewhat in the accompanying minerals.

In ore-bodies formed by the replacement of the country rock along and from fissures, it is to be expected that mineralization should often be irregular and the ore-bodies should show correspondingly irregular forms. This is here the case. Often the deposits have no definite walls, the country rock in the neighborhood being mineralized to a greater or less distance from the main deposit, the line between the two bhing often merely a commercial wall. Unmineralized portions of the country rock are apt to be found as remnants in the vein and bunches or masses of ore may wander into the country rock. The ore is usually found in the veins in the form of shoots of various outlines. Sometimes several of these occur, often rudely parallel. In some places veins with similar filling intersect at various angles. Small stringers leading from the main veins are not uncommon. Most of the larger veins have a northerly strike with a high dip to the east. In the case of the Knob Hill–Ironsides the dip is as low as 45 or 50 degrees. Not enough development work has been done to generalize on the forms and pitches of the shoots. That of the Mother Lode pitches south. In the B. C. mine, a horizontal plating of the ore is quite pronounced.

There have been considerable movements since the ore was deposited; numerous slips, some with gouge or secondary filling, traverse the ore bodies. This broken nature of the ground, coupled with the original irregularity in the form of the ore body makes the exploitation of the smaller deposits sometimes difficult and precarious. The slips so far encountered have not been sufficiently large to have seriously affected the larger deposits. The serpentine is particularly full of slips, some prior but many subsequent to the formation of the ores, which make it probably the least satisfactory country rock in the district.

The values in the ores are principally in copper and gold, sometimes with accessory silver. Further study is required to formulate the laws governing the distribution of gold values. Generally magnetite and pyrrhotite when occurring alone are almost barren, yet this is not always the case. In the Knob Hill–Ironsides the massive magnetite is said to have a gold value. This is said to be the case on the Seattle claim, but in an assay of this magnetite made for the writer no gold was found, though the accompanying chalcopyrite was auriferous. In the Winnipeg mine pure pyrrhotite carries as high gold values as have been found in the mine, but at other points in the same mine barren pyrrhotite is found. Chalcopyrite occurring in magnetite and pyrrhotite is generally a gold carrier, but the gold value of an ore does not always increase with the copper percentage. Thus in the Mother Lode the best gold values are said to be found where the ore runs about 2 per cent. in copper. In the B. C. mine the gold is said to be confined to the chalcopyrite—pyrite and pyrrhotite being barren. On the other hand, in the Brooklyn, Stemwinder and Rawhide the best gold values are reported from the pyrite and ore-carrying specularite. So far as could be superficially observed, the local opinion that the intersection of veins or stringers with the main bodies does not cause an enrichment, seems to be supported by the facts. It may be noted that where dykes cross the ore bodies there appears in some cases to be an enrichment of the ore. Possibly there may prove to be a relationship between the

* Geological Survey of Canada, N.S., Vol. 7, 1894, p. 341B.

† Zeitsch. für Praclt. Geology, 1894, pp. 177, 464; 1895, p. 154.

‡ Trans. Canadian Institute of Mining Engineers, Vol. 2, 1899, p. 72

quartz and the tenor of the ore. Though segregated in places, the chalcopyrite is on the whole remarkably evenly distributed through even the immense deposits. Away from the chief centres of mineralization while magnetite and pyrite are still sometimes found, the copper and gold are only sparingly present. The actual values of the ores per ton and the cost of mining and treatment have not been made public. The ores, as a rule, are certainly very low-grade, lower than was at first hoped. This has been partly counterbalanced by the size the bodies have shown on development and the remarkable adaptability of the ores to smelting. The magnetite, quartz and calcite are present in the required proportions so that no fluxing or roasting is necessary, so that the cost of smelting, as well as the cost of mining these ores, is exceptionally low. It is generally admitted that many of the properties can only be successfully operated by doing their own smelting; for this reason a union of the smaller mines or the building of a union smelter has been suggested.

A member of the Dominion Copper Company kindly furnished permission to publish the following figures regarding the contents of the ores of this company, which are more or less representative of the ores of Greenwood Camp.

Gross Returns.

Si O	39.00	per cent.	
Ca O	17.00	"	
Fe O	14.00	"	
Cu	1.95	" =39 lbs. Cu (at 10c. per lb.)	$3.90
AU		119 oz.	2.40
Ag		44 oz.	0.22

Net Returns.

Cu	$3.10
Au	2.40
Ag	.22
	$5.72

Values as high as $30 per ton are reported on car lots of ore from the Winnipeg mine, but such returns are exceptional, for the ores of the district as a whole.

The method of mining adopted in the large mines is to be presented in another paper and need not be referred to here.

A striking feature in the deposits is the lack of surface oxydation or alteration. At most, a few feet below the surface of the ground the ore exhibits the same characters as are found in depth. The soil overlaying a deposit is often quite unstained, offering no indication of the underlying ore, and consequently adding to the difficulties of prospecting; sometimes the surface of the ore even retaining the glacial polishing. The explanation of this feature is probably to be found in the heavy glaciation to which this region has been subjected. The old oxydized, and perhaps enriched, upper portions of the veins have been cut away by the Cordilleran glacier and since then the surface has been often more or less protected.

In Copper Camp oxydized copper-bearing veins occur, forming at first sight a totally different type of deposit. A short description of the King Solomon claim will illustrate this type. This deposit is found at a contact between a dyke of porphyry and crystalline limestone. Wedge-shaped tongues of the porphyry extend from the main dyke into the limestone. Both the limestone and the dyke are much fractured and traversed by little slips. These fractures cut the limestone into small blocks. In the limestone, and to a less extent in the fractures in the porphyry, along the contact, are deposited various oxydation minerals of iron and copper, including native copper. These embrace red massive and earthy hematite and yellow limonite, crystallized and massive malachite and azurite, a black amorphous substance, a mixture containing copper oxide (melaconite, lampadite and chalcocite), cuprite, often in transparent crystals, native copper, chrysocolla and probably copper-pitchblende. The edges of the small limestone blocks have often been dissolved and the copper ores then occur as encrustations surrounding a core of lime. The main fissures are filled with the iron and copper minerals, the smaller principally with the copper. In the porphyry it is only the fractures near the contact which contain a thin film of copper ore, the rock itself remaining fresh and unaltered. About 650 feet from the main working on the King Solomon is a small vein. The rock is here not so badly shattered. On the suface carbonates and other copper minerals with iron oxides are found; a little below the surface the sulphates of these metals occur, and below these unoxydized pyrite and chalcopyrite begin to appear. What can be seen to be taking place here on a small scale is probably what occurred on the King Solomon ledge proper on a much larger scale, so that this type of deposit is probably an oxydized and secondarily enriched form of a sulphide deposit, similar to the first type of Boundary deposits and produced by the action of surface waters. The iron of the sulphides has been removed or redeposited as hematite and limonite; the copper has been more or less concentrated in the form of various oxydized minerals. At greater depth the unaltered iron and copper sulphides will presumably be found, although between the oxydized minerals and the unaltered sulphides it is quite possible that a zone of enriched sulphides will be found. That a zone of oxydation and enrichment should be found in the veins of Copper Camp and not elsewhere in the district may in part be explained by the local topography, and the broken nature of the country rock, but the chief factor, in all probability, has been the capping of volvanic rocks which covers the hill-tops all around and extends almost to the King Solomon and other of these deposits. In glacial times these rocks are likely to have extended a little farther, in which case they would have protected the deposits from the scouring effects of the ice-sheet. In addition, the contact between the volcanic and older rocks is likely to be a natural waterway.

The quartz veins, constituting the third type of deposit, are found in the neighborhood of the first type, but seem more abundant on the outskirts of the areas of chief mineralization. They are sometimes parallel to the large sulphide bodies, but do not, as a rule, show the same regularity in their strike. In form they are more regular and they are usually enclosed between well-defined walls. Chalcopyrite, pyrite, arsenopyrite, galena and zinc-blende are the chief metallic minerals. Tetrahedrite and some rich silver minerals are said to have been found in some of these veins. The principal values are in silver and gold. High assays are reported to have been obtained from a number of these veins, but the only one at present being worked in the district embraced in this paper is the No. 7 mine. In age and mode of formation there have been little difference between these and the previous deposits, though in that case they would probably represent the closing stage of mineralization.

Some of the practical deductions from an examination of the ore deposits may be summarized as follows:—

Ores may be found in any of the older rocks where the other conditions for mineralization were favorable.

Districts which show evidences of late disturbances through vulcanism, manifested by intrusions of recent eruptives and heavy dyking, are promising fields for prospecting.

Limestone contacts in such areas should, in particular, be carefully prospected.

Since, with the exception of certain deposits in Copper Camp, there is no zone of oxydation and secondary enrichment in the main deposits, while the general conditions remain unchanged, no loss of values is to be expected in depth.

On account of the irregular form which the ore bodies may possess and the complex nature of the rock formations, a careful and detailed study of the surface of the ground in the neighborhood of the mines would be of great practical assistance in the exploitation of the ore bodies. For the same reason development work must always be kept well ahead of the actual mining. Cross-cutting must frequently be resorted to, to determine the actual limits of the deposit, and to prove

the existence or non-existence of parallel ore shoots. The limits of mineralization must be actually proved, and similarly only that ore can be with certainty reckoned on which has been actually blocked out.

In this connection diamond drilling can be used with advantage. Careful magnetic surveys would also be of great value in locating ore-bodies under the covering of drift, and also in testing for ore in the mines themselves. Especially good results should be obtainable by this method in the magnetitic type of deposit, but it should also prove successful in the pyrrhotitic deposits. It has proved successful in such deposits in Scandinavia, and I am informed that experiments made with it on the Sudbury pyrrhotite deposits, last summer, have yielded good results.

Where the ore occurs at a limestone contact the limestone wall may often be used for following the ore, it being kept in mind that the ore does not always follow strictly along the contact, and that the limestone may pinch out without causing the ore to likewise give out. The dykes in some cases may be used in the same way.

The pyrrhotite and magnetite should always be assayed, as barren-looking material may carry good pay values. The minerals in the ore and the conditions where pay values occur should be carefully studied with a view to ascertaining which carry the values, and what were the causes which produced the concentration of values. The porphyry dykes themselves, while not mineralized in the same way as the country rock, may in places prove auriferous. In a specimen from a similar porphyry dyke, from the Valkyr mountains, east of Lower Arrow lake, examined last winter, free gold was plainly visible, even with the naked eye.

In prospecting it is to be remembered that float may have been carried a considerable distance, even across valleys, by the former glacier. The general course of the latter was about S. 30 E., but it was influenced by the local topography.

In a promising deposit of the oxydized copper type, one would be warrented in testing the deposit to a sufficient depth to ascertain if a zone of enriched sulphides exists between the oxydized zone and that of the unaltered sulphides. As *Emmons and Weed have pointed out, the bonanzas of high-grade ore in Butte, in Arizona, and other points, are situated between the zones of oxydation and unaltered sulphides. Below the limits of alteration the deposit may or may not be rich enough to work.

On the Possible Occurrence of a Coal Area Beneath the Neo-Carboniferous or Peruvian Strata of Pictou County, Nova Scotia.

By Dr. H. M. Ami, Ottawa.

"The Pictou Coal Field is of a very complicated character," wrote Sir William Logan in 1869,† as he described a portion of the Pictou coal field, Nova Scotia. All previous and subsequent workings of coal seams in that field have corroborated the view there expressed by this eminent field geologist, as one may gather from the numerous writings of the Messrs. Poole, Hartley, Dawson, Gilpin, Fletcher, Rutherford, and others. "Undulations, important faults," or dislocations combine to make mining in this area rather difficult and intricate.

Millions of tons of bituminous coal have been obtained from the mines within the Pictou coal field. The Acadia and Intercolonial collieries together produced no less than 590,638 tons in the year 1900. The various workable seams have been described carefully, from the "main seam" to the smallest workable stratum of coal, and their respective character need not be entered into here.

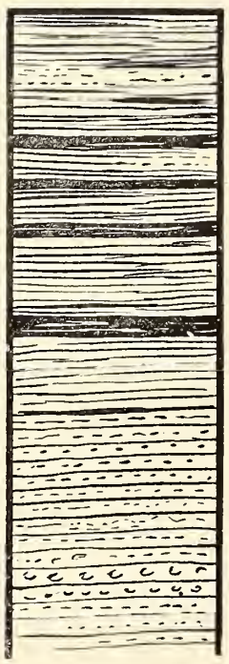
One of the most important faults of the district is that known as the "North Fault," to which is ascribed a vertical displacement or throw of several thousand feet. Alongside this fault, and in the vicinity of its line of outcrop, near Blackwood Brook, New Glasgow, the black bituminous and coal-bearing shales and strata of the Stellarton formation, which carries the productive coal measures of the Pictou coal area to the south of this fault, as recognised in the Vale, Acadia, Intercolonial, and other mines of the area, are seen to abut against the tilted sandstones and associated strata of the older and subjacent Westville formation, the latter constituting the so-called "millstone grit" formation of European geologists—subjacent to the coal-measures of England, etc., and very doubtfully the equivalent of the Westville formation of Canada.

There is but a narrow strip of the Westville formation visible in the Blackwood brook in New Glasgow (west side), between the outcrop of the New Glasgow conglomerates (which in their eastward extension constitute Fraser's mountain) and the "north fault," but larger areas of this formation occur both east and west of this point; east, over the area on which the telegraph road runs from New Glasgow to Weir's Mill and Sutherlands' Bridge, etc., as well as west of New Glasgow. At this point there occurs, therefore, a conspicuous unconformity, in which a series of newer conglomerates and sandstones capped by calcareous bands of sandstone, as well as some shales and freestones, cap unconformably the tilted measures of the Westville formation, otherwise designated as the "millstone grit."

That the tilted strata which are seen to underlie the New Glasgow conglomerates and their superjacent formations in Pictou County, north of Blackwood brook, are of "millstone grit," or Westville age, has been generally conceded by many geologists, in fact, by all who have described the geological or underground structure of that portion of Nova Scotia, and I have not seen any reason, as yet, why this view is not correct, and therefore accept it until such evidence is forthcoming to clearly disprove it.

It is well known that in the neighbourhood of the town of Westville and the areas south of the "north fault" generally in Pictou County, down to the south fault, and east of the west fault the Westville formation, in its normal development, is always capped by the Stellarton coal-bearing formation, and would present, if undisturbed, the following succession as represented in Diagram A.

FIG. A.



In Figure A the Stellarton formation, or productive coal measures

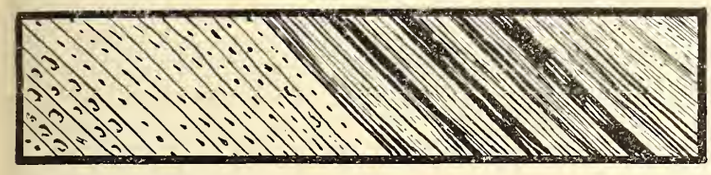
* Trans. American Institute of Mining Engineers, Vol. XXX.

† Report of Progress, Geol. Survey, Canada, 1866–69, p. 4. 1870, Montreal.

of Pictou county, rest directly over the Westville sandstones, grits and conglomerates, or "millstone grit" formation of most writers, so that wherever the productive coal measures of the Stellarton formation occur in their normal condition of deposition, undisturbed by faulting and tilting, the Westville sandstones and grits would be reached by traversing the Stellarton shales and coal seams.

Inasmuch as the original structure and condition of the strata since deposition have been considerably changed by later dynamic forces at work in the Pictou coal basin, and these have dislocated the strata, tilted them in many localities and let down into the depths of the earth between some of those deep faults which affect the carboniferous measures of this field, the productive and workable seams, so as to protect them from agencies of erosion which came subsequently, one of these changes may be best illustrated by means of a diagram—(See Figure B)—illustrating the case where the Westville and Stellarton formations are tilted at a high angle and their edges denuded.

FIG. B.



WESTVILLE
Formation or
"Millstone Grit."

STELLARTON
Formation or
"Coal Measures."

It will thus be seen that the Westville formation, with its sandstones, grits, and conglomerates, underlie unformably, and in its regular and normal position, the shales and productive coal seams and associated strata of the Stellarton formation. The block of Westville and Stellarton strata, thus represented in Figure B, though diagrammatical, nevertheless shows the relations which these two district geological formations bear to each other in various portions of the Pictou coal basin, south of the "north fault," and which may possibly obtain north of the same fault in the area in question and discussed in this brief paper.

Supposing, now, as is the case in the outcrop of the strata of the Westville (or millstone grit) formation at Blackwood brook, that its strata dip at an angle of 60 degrees towards the north, presenting the upper edges of the strata in an eroded condition, then, in the event of the succession of the carboniferous strata, these being normal and regularly without the intervention of a fault (of which there is no evidence whatever), it is reasonable to suspect—provided the unconformity prevails for a considerable distance north of the "north fault," in the direction of the mouth of the East river of Pictou or of Pictou town—that the newer and higher stratas constituting the Stellarton formation, or productive coal measures, will be found overlying the sandstones of the Westville formation exposed on Blackwood brook somewhere to the north, and the contact between these two formations would be somewhere between the latitude of Pictou town and that of Blackwood brook. The contact of the two formations—if it exist at all—is hidden by the overlying strata of the New Glasgow conglomerate formation, and the various geological horizons or formations which overlie the New Glasgow formation perfectly conformably, up to the measures of the overlying and newer Pictou and Cape John formations, which, by some geologists, are classed as Permian, by others as permo-carboniferous, and by others still as members of the carboniferous system.

Unfortunately there is but little of the Westville strata exposed in Blackwood brook, and also very little of the contact between the two unconformable series visible.

The bevelled appearance and condition of the Westville strata in Blackwood brook clearly indicate strong erosion by wave-action at the time of the deposition of the New Glasgow conglomerate, and subsequent formations, the tilting having taken place not very long after the deposition and hardening of the strata.*

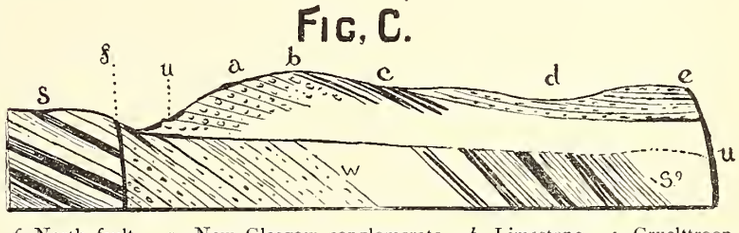
While the plane of marine erosion was being formed in the underlying tilted series of strata the wave action was accumulating the materials which now constitute and make up the New Glasgow formation of Fraser's mountain as well as the formations of impure limestone, sandstones, clays, sandy shales, bituminous shales, freestones, and conglomerates overlying the New Glasgow formation, and these materials, as may be gathered from the false bedding visible and the general character and structure of these materials deposited in these formations indicate rapid deposition or accumulation. Two or three small coal seams occur in these newer sediments also, whilst not a few of the layers of sandstone show innumerable grains of coaly matter—grains of coal, coal dust—accumulated or spread over the layers and throughout the strata themselves, along the divisional planes of stratification.

Taking for granted, then, as we did at the outset, that the New Glasgow conglomerate overlies the "millstone grit" or Westville sandstones at Blackwood brook, which latter dip to the north, why can we not expect to meet the productive coal measures on Stellarton coal-bearing shales and shaly strata by boring through the new overlying strata capping the tilted series of strata unconformably?

The very pressure of coal dust or finely broken coaly matter disseminated over the surfaces of the overlying strata predicates, in my mind, the fact that erosion in strata that were probably coal-bearing, though I must confess that the erosion of the shales would lead to the deposition of clays and mud-stones, which are, however, conspicuous by their almost total absence in the section from New Glasgow to Pictou or Cape John.

As to what portion of the Westville formation crops out along the line of contact and unconformability at Blackwood brook has not been ascertained precisely as yet, as far as I have been able to ascertain. Accordingly, at what distance north of the north fault and New Glasgow the top beds of the Westville formation occur and the beds of the

FIG. C.



f. North fault. *a.* New Glasgow conglomerate. *b.* Limestone. *c.* Gruelttroon shales. *d.* Pictou sandstones. *e.* Cape John red beds. *u.* Line of contact: unconformability. *s.* Stellarton coal-bearing shales. *s?.* Possible position of coal-bearing strata. *w.* "Westville" or "millstone grit" formation of authors dipping north.

Sketch section of geological formations between Stellarton coal field and Pictou town, showing position of the North fault and the relation of the newer overlying strata to the underlying series which may be a repetition to the north of the fault of the Pictou coal area now worked to the South.

Stellarton coal-bearing formation begin, depends entirely upon what portion—the lower, middle, or upper portion—of the Westville series crops out in the bed of Blackwood brook.

The newer or overlying series consist of more or less horizontal strata, and the precise thickness and extent of this formation has not been definitely ascertained as yet by boring. Should boring operations be carried on so as to give the locality a fair test to ascertain the probable occurrence of a coal field north of the great north fault, and in

* NOTE.—The faunas and floras discovered entombed in the overlying series of newer strata indicate an upper carboniferous facies with Permian affinities in the highest beds of the strata in Pictou County, near Cape John. It is difficult for me to be thoroughly persuaded that the tilted strata of Blackwood brook are of the Westville or "millstone grit" age.

the vicinity of and underneath Trenton or the country to the north, between the Straits and the fault, such boring operations will furnish the geologists with much data that are necessary and requisite in order to be able to state with precision to what thickness the overlying strata cap the tilted and supposed coal-bearing beds beneath.

That there should be a possible coal-field beneath the newer overlying series and in the inclined beds below is a question of much interest and worthy of more than cursory notice.

The prevalence of the coal basin depends upon the continuity of the unconformable contact between the two series of sediment, such as are exposed in Blackwood brook.

It may not be out of place here to state that far back an attempt was made to put down a bore hole with a view of obtaining coal, but inasmuch as the hole was not carried down to a great depth, neither was a careful log preserved of the strata traversed during boring operations, the results were negative rather than positive, and whilst at Blackwood brook the underlying, tilted series of beds are near the surface of the ground, and a few hundred yards north of the brook, probably only a few hundred feet from the surface of the ground, the precise thickness of the overlying strata can only be ascertained by boring or sinking a shaft.

It is to be hoped that before long the locality in question will receive a fair test—bore holes put down so as to traverse the newer overlying series—in order to ascertain the occurrence or non-occurrence of the coal-bearing shales and strata of the Stellarton formation in that portion of Pictou county north of the "north fault"

CORRESPONDENCE.

The Electrolytic Production of Metals, with Special Reference to Copper and Nickel.

SIR—In accordance with your request, I herewith send you a few notes with a view to correcting certain statements in Mr. Koehler's interesting article on "Electrolytic Production of Metals" in the April number of your excellent REVIEW.

In the first place, the statement made on page 97 of the article in question to this effect, that the two principal processes for the recovery of metals from their solution are those of Siemens and Halske and Hoepfner, certainly needs modification, as Mr. Koehler will readily admit that fully 90 per cent. of all the copper recovered from its solution is obtained by neither of these processes, but from acid sulphate solutions by ordinary electro deposition with soluble copper anodes, which is essentially the old Elkington process, patented in 1865-70.

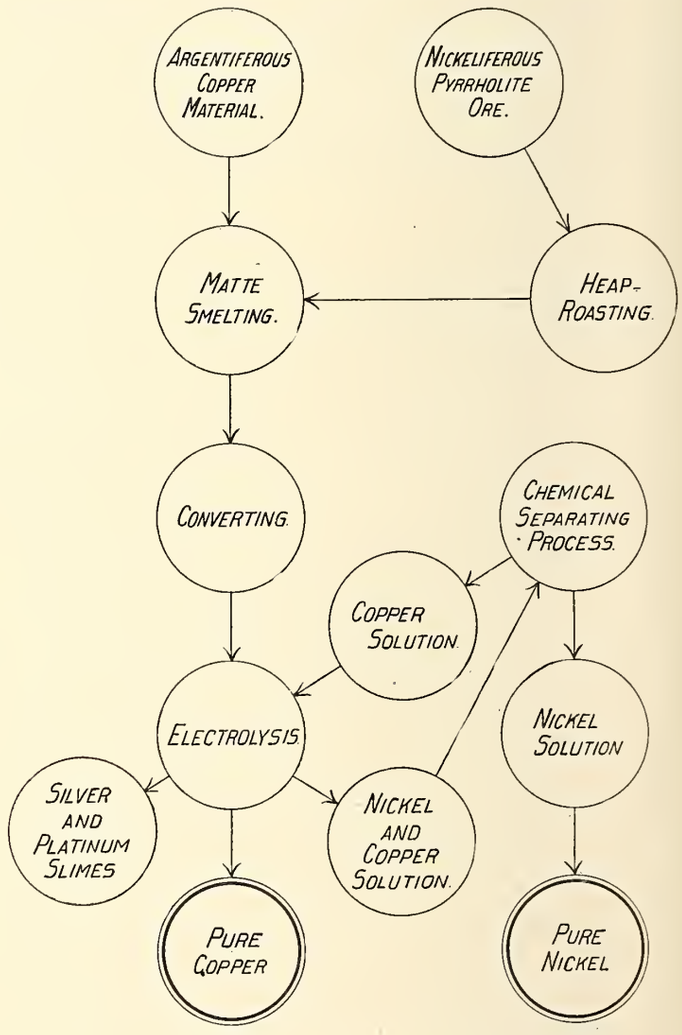
While it is true that the Hoepfner process, or rather a modification of this process, is being practically applied, both at Cleveland and Papenburg, in the production of a limited tonnage of electrolytic copper and nickel, it is likewise true that the solution and deposition of copper and nickel from chloride solutions is neither as rapid and simple in reaction as it is with sulphate solutions, nor as economical, all things considered, and the Hoepfner process was therefore abandoned by several companies after extensive trial.

Now to another matter. Mr. Koehler, on page 96 of his article, mentions and shows a diagrammatic sketch of the process I proposed years ago for treating Sudbury ore, giving me full credit, but adds that this is the process I now propose using at Sault Ste. Marie, which is wrong. As a matter of fact the process I advocate does not include separation smelting (the Bartlett-Thompson or Orford process), as Mr. Koehler states, as this is a patented process, both cumbersome and imperfect in effecting the separation desired, and is not at all necessary in my method of treatment.

My improved process, which is protected in Canada, the United States, and in Great Britain, embrace the following essential features and improvements:—

1. The difficulties hitherto experienced in attempting to bessemerize nickel-copper matte to a higher percentage than 80 per cent, involving losses of cobalt, etc., are entirely obviated, in my process, by the addition of sufficient copper bearing material in the matting furnace to reduce the percentage of nickel in the converter charge to 20 per cent. or less of the copper present. I am thus enabled to convert the matte up to 95 per cent. metal and above, instead of 80 per cent, and I also reduce the total percentage of metal going into the converter slag, and which, of course, requires retreatment, by largely protecting the slagging-off of the nickel by the copper.

2. The crude nickeliferous and argentiferous copper is cast into anode plates and hung in electrolytic tanks in an acid sulphate solution, just as in ordinary copper refining, and pure copper plated out on copper cathode sheets.



3. What I consider the most important feature of my process consists in the regular withdrawal of a small proportion (say 2 per cent.) of the total quantity of electrolyte in circulation in the copper depositing tanks, firstly, in order to keep down the increase of the nickel contents in the same, by replacing the withdrawn solution by one practically free from nickel, and secondly, in order to accomplish the regular recovery of the nickel, which is extracted from the withdrawn electrolyte by simple chemical means, followed by electrolysis.

4. Pure nickel is readily obtained, in my process, by electrolysis

of the slightly ammoniacal, heated, nickel sulphate solution with lead anodes, depositing the nickel on nickel cathode sheets, and remelting and casting of the cathodes into whatever shapes are desired. The subjoined plate shows a diagrammatic scheme of the essential steps of my smelting and refining process, as applied to nickel and copper material.

Trusting that the above contains the information you desire, and which you may publish as stated,

I am, very truly,

TITUS ULKE,
Supt., Copper Refining Dept.,
Lake Superior Power Co.

Sault. St. Marie, 27th May, 1902.

SIR—Your favor of the 30th to hand. In answer to Mr. Ulke's criticism (statement page 97), I would reply that I purposely did not enter upon the subject of refining, knowing very well that almost everybody is well aware of the fact that about 90 per cent. of copper used at present time is electrolytically produced through the refining of crude copper from an acid snlphate solution. This process is so old and so well known that giving details of same is more or less a waste of time.

There is a vast difference between refining using soluble anodes, when the deposition of metal upon the cathode depends upon the metal contents of the anode going into solution, and having simply a solution of a metal from which metal is being precipitated, without the solution's metallic contents being replenished.

In accordance with the last statement, the Siemens and Halske and the Hoepfner process are the only two recognized processes.

2nd. Page 96—Mr. Ulke's process.

I am not accountable for any changes, improvements, etc., etc., which Mr. Ulke has decided to adopt since his proposal of proceedure a few years ago.

All metallurgical processes are more or less subject to deviation.

In Mr. Ulke's description of his improved process, section 2, he cites: "Crude nickeliferous and argentiferous copper is cast into anode plates and hung in electrolytic tanks, in an acid sulphur solution, just as in ordinary copper refining, and pure copper plated out upon copper cathode sheets"; while in Europe (1895) scrap metal containing about 75 per cent. copper and 25 per cent. nickel, also mixtures of iron, copper, nickel, silver, and zinc, in other words, nickeliferous, or more generally speaking, metaliferous copper, was cast into anodes, hung in an electrolytic tank in an acid chloride solution just as in ordinary copper refining (except the substitution of an acid chloride solution for an acid sulphate solution), and pure copper plated out on copper cathode sheets.

I am pleased with Mr. Ulke's criticism, and would like to have you publish same in your valued paper, together with the above remarks.

Thanking you for past favors,

Very truly yours,

WM. KOEHLER.

Cleveland, 2nd June, 1902

SIR—Allow me to again call your attention to Mr. Ulke's criticism.

1st. Mr. Ulke evidently has not carefully looked over the paper re copper and nickel production.

On page 95 MINING REVIEW, 2nd paragraph (1st page of article), is stated the following:—

"Electro-metallurgy is divisible into two branches, first, the *electrolytic refining of crude metals*, and second, the direct production of metals from their solutions."

The Siemens and Halske and the Hoepfner processes are the two recognized methods of obtaining metals *direct from their solutions*. This statement needs no modification.

2nd. It is a well-known fact that about 90 per cent. of copper used in arts is obtained through refining of crude metal from an acid sulphate solution. This subject comes under *1st heading refining*, and was purposely only casually mentiened. The process is so old and so well known that in giving details of same is more or less a waste of time.

3rd. Regarding the advantages or disadvantages in obtaining metal from a sulphate against a chloride solution, it is my impression that the time will come when a chloride solution will more or less supersede a sulphate solution.

In the electrolysis of a sulphate solution no valuable by-product is obtained at the anode, while with chloride solutions you obtain (from a nickel chloride solution), for every 59 equivalents of nickel 71 equivalents of chlorine gas.

It is a well known fact that the electrolysis of a chloride solution will require a trifle more costly apparatus than will that of a sulphate solution. There will also be a slight difference in the power factor (viz., energy necessary for electrolysis), but when it comes down to dollars and cents I believe the chlorine gas obtained will more than overbalance the difference. The Canadian Copper Co. think they have their process down very nearly to perfection. This speaks well for chloride solutions.

4th. Mr. Ulkes' process has been cited according to his proposal of a few years ago.

I am not responsible for the Orford Copper Co. upholding their patented separation smelting process in Canada, neither am I accountable for any changes or improvements which Mr. Ulke may have made since he has begun practical operations.

All metallurgical processes are subject to deviations according as necessity demands.

5th. Mr. Ulke's improved process, section 1st:

The object of this paper has not been matting and converting mattes, etc., to the state of crude metal. This is a subject foreign to electrolysis.

6th. Section 2nd. Concerning crude nickeliferous and argentiferous copper cast into anode plates and refined. Mr. Ulke certainly does not claim anything new for this.

While in Europe in 1895, scrap metal containing 75 per cent. copper and 25 per cent, nickel, also mixtures of copper, iron, nickel, silver. and zinc, in other words nickeliferous copper, or more generally speaking, metalliferous copper, was cast into anode plates suspended (identically as in copper refining in an acid sulphate solution), both in acid chloride and acid sulphate solutions, also in neutral and alkaline solutions and fine metal, obtained upon sheet copper cathodes.

7th. Section 4th. Concerning the winning of pure nickel by Mr, Ulke's process, through the electrolysis of a slightly heated ammoniacal nickel sulphate solution with lead anodes.

This method is the analytical method of determining nickel adapted to commercial use, which has been used in analytical laboratories for years, the substitution of a lead anode for the much more expensive platinum anode, and the use of an electrolytic bath of large dimensions, instead of beaker or a platinum dish, being the principal differences.

Very truly yours,

WM. KOEHLER.

Cleveland, June 4th, 1902.

SIR—In reply to Mr. Koehler's interesting comments upon my remarks, I beg to submit the following, and thank you for your kindness in allowing me space for this discussion, which, I trust, will be final, as practical work of very pressing importance is keeping me so busy, nowadays, that I have but little leisure, unfortunately, for digressions of this sort.

Allow me to take up Mr. Koehler's comments in their order :—

1st and 2nd. After carefully looking over Mr. Koehler's interesting article, I noticed the unscientific and illogical character of his classification of electrometallurgy into the two following branches, viz. : 1, the electrolytic refining of crude metal, and, 2, the direct production of metals from their solution. Every metallurgist should be aware that the second branch is covered by the first, and that *the direct production of metals from their solution* is the final step of *every* electrolytic refining process.

3rd. Regarding the advantage of obtaining metal from a sulphate as against a chloride solution, this fact certainly seems decisive, that those in charge of our large electrolytic refining works have never been prevailed upon to adopt the chloride solution method, instead of the method at present in almost universal use, for many reasons. *The chloride method is old*, has been tried under a great variety of conditions and with many modifications, *but has not yet attained commercially practical prominence.* Electrometallurgists are aware that the speed of reaction is too slow, and the apparatns and process too complicated for ordinary practical purposes. In a few cases it may be desirable to utilize the evolved chlorine, and the chloride method may then be be found suitable, but it is out of the question, at the present time, for large refiners to go to the expense of erecting a costly plant for liquifying chlorine gas or making bleaching powder when it is considered that the returns would be reduced to an unprofitably low figure as soon as such methods were generally adopted and the market flooded with chlorine obtained in this way.

The only electrolytic nickel and copper refinery running, I believe, in America at the present time, is the Canadian Copper Co.'s small plant near Cleveland. This company may or may not think that they have their process down to perfection, and they may soon have reason to revise their claims, just as they are beginning to see that their Sudbury mine equipment is not the best, nor that their method of handling ore to and from roast heaps is the cheapest.

4th, 5th, and 6th. Does not require any comment.

7th. Concerning obtaining pure nickel through the electrolysis of a slightly heated ammoniacal nickel sulphate solution, *with lead anodes*, I beg to note that Mr. Koehler is in error when he states that this is is the analytical laboratory method in use, for it certainly is not. I will add, in conclusion, that United States, Canadian, and British patents have been granted to me, covering the use of lead anodes in such solutions in electro-depositing nickel.

You would confer a favor by sending me a copy of this discussion, if it should appear in print. Thanking you for your kindness,

I am, very truly,

TITUS ULKE.

Sault Ste. Marie, Ont., 9th June.

British and American Capital in British Columbia.

SIR—Your correspondent, Mr. Best, in his paper on "The Minerals of Vancouver Island," printed in your issue of May 31, states "That at present most of the developed mines in the Province of British Columbia are in the possession of United States citizens, while England quietly slumbers, etc., etc." This assertion I regard as so misleading that it must not be allowed to pass without challenge. The facts are quite the other way. Englishmen have, during the past ten years, interested themselves largely in mining enterprises in this Province, and at the present moment they own and are operating something like one half of the principal mines in British Columbia, as, for example, the Le Roi mine and Northport smelter, Le Roi No. 2 group, Rossland Great Western, Kootenay Mines, Velvet, Portland, Ymir, Arlington, Snowshoe, Jewel, Ruth, Whitewater, Enterprise, Idaho, Bosun, Silver Cup, Highland, Lavinia group, Granite and Poorman, Queen Bess, Hall mines and Nelson smelter, not to speak of a very large number of less well-known claims and of heavy holdings in shares of innumerable local companies. If to the above-named list of properties controlled in the old country, we add the large number owned by Canadians, among which may be named the Centre Star, War Eagle, Payne, Molly Gibson, St. Eugene, Cariboo-McKinney, B.C., Brandon and Golden Crown, Winnipeg, Yellowstone, London Consolidated, Paradise Group, Crow's Nest Pass Coal Company, Mollie Gibson, White Bear, it would certainly seem as if British and Canadian enterprise has not been found wanting in this Province. Possibly Mr. Best's contention may be correct if limited to mining developments on the Island of Vancouver, but in seeking to apply it to the condition of affairs existing throughout the Province generally, he seems to me to have spoken at random and therefore incorrectly,

Yours faithfully,

F. W. ROLT.

Rossland, B.C., June 16, 1902.

MINING INSTITUTE.

Eastern Ontario and the Eastern Townships Organise District Branches.

In accordance with the policy of the Institute, inaugurated at the last annual general meetings, a successful start has been made with the organization of district branches of the Institute. These have been formed in Eastern Ontario with headquarters in the City of Kingston and in the Eastern Townships with Sherbrooke as a centre. Other branches will be formed later in British Columbia, at the Sault, at Rat Portage, in the Province of Nova Scotia, and at other points. The membership of the Institute which now includes close upon 400 active members and nearly a hundred student-members has been considerably augmented by the acquisition of the two new sections.

EASTERN ONTARIO BRANCH.

The meeting at Kingston on Monday evening, 2nd June, was well attended by local mining men, and considerable interest was taken in the proceedings which lasted until midnight. Dr W. L. Goodwin, director of the School of Mining, occupied the chair. Mr. Joseph Bawden, secretary *pro tem*, opened the proceedings by reading the minutes of a meeting held during the week previous at which it had been decided to organise a local branch. A motion to the effect that "The Eastern Ontario Section of the Institute be now formed" was then put to the meeting and adopted.

The following gentlemen handed in their names for nomination to membership subject to the approval of the Council : Dr. W. F. Coy, H. W. Richardson, Geo. Smith, John Donnolly, M.E., G. O. Grover, J. A. Madill, A. M. Chisholm, Fred. A. Folger, jr., Joseph Francklyn, R. E. Kent, all of Kingston ; David Williams, C.E., Port Arthur ; A. H Brown, Metallurgist, Canadian Gold Fields Ltd., Deloro ; Fred. Foxton, Sydenham ; Thos. Caldwell, Lanark.

The following committee of management was then elected :—

Dr. W. L. Goodwin, Kingston, Chairman.
P. Kirkegaard, M.E., Deloro.
Prof. Carr-Harris, C.E., Kingston.
Prof. S. F. Fitzpatrick, Kingston.
John Donnolly, M.E., Kingston, Secretary.

Dr. Goodwin then read a paper on the subject of "The Occurrence of Mica in Eastern Ontario" which, after some interesting discussion, it was decided to take up again at the next meeting of the Section.

The question of the establishment of the proposed new Department of Mines was also discussed and the local secretary was authorised to wire to Hon. the Minister of the Interior endorsing the proposal to establish such a Department and urging its organisation at the earliest possible opportunity.

At the meeting there was exhibited a very handsome series of phlogopite crystals from the Stoness-Kent mine, and some very fine samples of molybdenite from the Chisholm mine near Kingston.

The Section adjourned to meet again at the call of the chairman.

EASTERN TOWNSHIPS BRANCH.

A meeting of the Institute for the purpose of organising a local Section to the Eastern Townships was held in the Council Chambers, Sherbrooke, Que., on Tuesday evening, 10th June. Mr. George R. Smith, M.L.A., General Manager of the Bell's Asbestos Company, was called to the chair.

The Chairman, in opening the meeting referred to the influence and importance of the Institute which had done much to promote the interests of the mining profession in Canada. The mining industries of the Eastern Townships were not heard of very much in the papers, for they had no stock to sell, or schemes to unload, but he ventured to say that their asbestos, chrome and copper mines would take rank industrially with any other of the mining industries of Canada. While at the moment they were not threatened by taxation on the products of their mines, there had been some talk, and there were some people who openly advocated an export duty on asbestos, so that it was well to be prepared to meet any such emergency. Such emergencies could best be met by organisation. A local branch of the Institute would give facilities for local mining men to meet together, and would, doubtless, be made an excellent medium for advancing the great mineral wealth thay they knew existed in the Eastern Townships.

Mr. B. T. A. Bell, secretary of the Institute, explained that the main idea the Council had in organising these branches was to give greater opportunities for local mining men to meet together than were afforded by the annual meetings of the Institute. By the formation of such a branch in Sherbrooke he thought much could be accomplished on behalf of the mines and mineral wealth of the district.

Mr. S. W. Jenckes, Sherbrooke, moved "That the Eastern Townships Branch of the Canadian Mining Institute be now formed." Mr. Jas. R. Pearson, Danville, seconded the motion. The chairman put the motion which was carried unanimously.

The following gentlemen handed in their names for election as members subject to the approval of Council: Jas. R. Pearson, Managing Director, Asbestos and Asbestic Co. Ltd., Danville; H. J. Williams, Manager, Beaver Asbestos Co.; J. A. Dresser, M.A., Richmond, Que.; Jas. R. Woodward, Wm. Farwell, James MacKinnon, W. S. Dresser, of Sherbrooke, and P. L. G. Mackenzie M.L.A., of Richmond.

The following committee of management was elected :—

George R. Smith, M.L.A., Bell's Asbestos Co., Chairman.
H. J. Williams, Beaver Asbestos Co., Thetford Mines.
S. L. Spafford, Nicholls Chemical Co., Capelton.
John Blue, C. & M.E., Eustis Mining Co., Eustis.
Jas. R. Pearson, Asbestos and Asbestic Co., Danville.
B. Bennett, King Bros., Thetford Mines.
James S. Mitchell, Sherbrooke, Que.
A. S. Johnson, Johnson's Co , Thetford Mines.
R. T. Hopper, Standard Asbestos Co., Montreal.
J. Dresser, M.A., Richmond.

Mr. Jas. R. Woodward, Sherbrooke, was elected secretary *pro tem.*

Mr. C. C. Hansen, Montreal, read a very interesting paper on the subject of "Power Drills" which we hope to reproduce in a future issue of the REVIEW.

Mr. F. Stacey Shirley read a paper on the Electric Drills, in which he described the new Gardner electric machine.

COPPER-BEARING ROCKS OF THE EASTERN TOWNSHIPS.

Mr. J. A. Dresser, M.A., Richmond, presented the following abstract of his paper read before the Montreal meetings of the Institute :—

"The copper-bearing rocks of the Eastern Townships of the Province of Quebec have long been known to comprise three principal belts which run approximately parallel to the northeasterly trend of the Green mountains in their extension into Canada. These belts are about twenty-five miles apart where crossed by the St. Francis river, and are themselves some two miles wide in each case along that river although elsewhere they are often considerably wider.

The most westerly of these, which is the first met in approaching the district from the St. Lawrence valley, is an extensive band of limestone which is sometimes associated with glossy black slates or graphitic shales. Small igneous intrusions are known to occur in the vicinity of most of the copper deposits of this belt, and in some cases the igneous rock itself carries copper. The best known deposits in this band are the once famous Acton Mine, the adjacent deposits at Upton, as well as the mines formerly worked at Roxton, Wickham and St. Flavien.

The central, or Sutton, belt contains amongst others the Harvey Hill mine at Leeds, the Halifax in the township of that name, the Viger in Chester, the St. Francis in Cleveland, the Belrath in Melbourne, and Sweet's mine in Sutton. The country rock of this belt has been generally described as chloritic, micaceous, talcose or nacreous slate and has been regarded as sedimentary in origin and the correlation of various deposits has been made on that assumption. Within the last two years, however, it has been found by the writer that these rocks in most cases at least are disguised volcanics of early geological age and much altered in character. Copper is found, not in true veins, as far as observed, but in lenticular masses conforming to the well-developed cleavage of the rock. The gangue is commonly calcite and quartz, and the character of the deposits such as to indicate their deposition contemporaneously with the gangue. The secondary derivation of the ore from the country rock is further evidenced by the fact that the latter commonly yields a small percentage of copper on assay.

Still more recently a similar discovery regarding the nature of the rock in the Ascot belt, the most easterly of the three bands, has been made by Mr, G. H. Pierce, C.E. This area includes, amongst many others, the widely known Albert and Eustis mines at Capelton, the Howard and others at Suffield, the Ascot and the Sherbrooke, nearer the City of Sherbrooke, the Moulton Hill, a few miles east of the St. Francis river, and the Garthby deposits, forty miles farther eastward. The country rock has not been usually described as differing essentially from that of the Sutton belt in general character, unless it be that the micaceous and nacreous slates have been to found predominate in the former while the chloritic prevail in the latter.

During the course of a recent visit to the Suffield mines, Mr. Pierce observed a massive appearance in the hanging wall of the Silver Star mine which suggested to his practised eye the probability of its igneous origin, although the sedimentary character of the rock, a supposed sandstone, had not been hitherto questioned, as far as can be learned, by the many previous observers of it during the past fifty years. A specimen which was handed the writer by Mr. Pierce proved, on microscopic examination, to be a quartz porphyry, the rapidly cooled equivalent of a granite.

As the rock was known to be one of considerable extent, specimens were subsequently taken by the writer at various points across the belt between Sherbrooke and Lennoxville and from several of the nearest mineral deposits. From these it is apparent that the Ascot belt, like that of Sutton, is a complex mass consisting chiefly of old and highly altered volcanic rocks.

The whole igneo metamorphic complex is occasionally cut by dykes which from their undisturbed position and fresh state of preservation are evidently of a very much later age than the main rock masses. The dykes were the latest rocks to form in the region, while the country rocks were the earliest, thus showing this belt to have been the scene of volcanic eruptions at very widely different times, at one or more of which the lavas ejected carried copper, silver and gold. From the fact that the ore bodies in many instances follow the cleavage of the rock, the form thus given the deposits causes them to easily simulate bedded veins which they have commonly been thought to be, owing to the cleavage having been generally mistaken for stratification- In view, however, of the igneous character of the country rock, the correlation of various deposits on assumed stratigraphical grounds becomes useless both in the case of the Ascot and of the Sutton belts, and opinions regarding the mode of occurrence of the ores also call for revision.

Concerning the deposits of the Ascot belt, Dr. Ells wrote in the Report of the Geological Survey, 1888-1889, (p. 56 K), "it may be very safely predicted that the real value of many of the mines which were opened twenty-five years ago and speedily closed, has never been ascertained, and that other masses of ore of equal importance to those so long worked, will, at some not distant date by careful prospecting be found. Much of the failure of twenty-five years ago was, doubtless, due to the speculative character of the work done. Mines were bought and sold on the flimsiest sort of evidence as to their value or worthlessness; often on samples which were obtained from an entirely different location from that represented. The growing importance of these ores as a source of supply for sulphuric acid is being fully realized by the men interested in this industry in the United

States and their superiority over most of the ore there found, for this purpose, being acknowledged. They are yet in this eastern belt many places thickly covered by forest growth, the prospecting of which is a difficult matter, but of the many mines already opened and abandoned it is highly probable, as in the case of those now worked, that deeper and more scientific testing would change the aspect of things greatly for the better."

Dr. FRANK W. ADAMS (Montreal) paid a tribute to the thoroughness with which Mr. Dresser had carried out his studies of these rocks. He thought his investigations had a most important bearing upon the future success of copper mining in the Townships.

Mr. B. T. A. BELL said it was a pity the Quebec Government made no appropriation to encourage original investigation of this character.

The CHAIRMAN said he believed something might be done towards extending the usefulness of the present Mining Bureau, if proper representations were made to the Government. He could promise them that he will cordially support anything calculated to promote the mining industries of the Province.

Mr J. R. WOODWARD stated that the copper deposits of the townships had been receiving his attention, and he was firmly convinced that many of the old mines, which had been abandoned years ago, could be reopened and worked at a profit. There was enough ore in sight to warrant the installation of a custom smelter having a capacity of at least 100 tons daily. He pointed out that not only Sherbrooke county, but Stanstead, Richmond and Wolfe, and Bagor counties were permeated with promising undeveloped copper properties. Work on these and other mines would be stimulated by the establishment of a smelter at Sherbrooke.

Mr. WM. FARWELL concurred with the other speakers in the great resources of the Province in copper ores. The Federal Government had granted bonuses to the iron and steel, and the silver and lead industries, and he thought some encouragement might also be fairly asked for the production of copper.

Mr. OBALSKI, inspector of mines, said but few people really realized the great wealth of the Province in its resources of copper ore, and he would cheerfully render whatever assistance was in his power towards bringing the claims of his industry to the attention of the Provincial Government. He had just returned from Matane, where a very remarkable discovery had been made.

After some further discussion, the following committee was appointed to take action with respect to the copper question: Wm. Farwell, J. S. Mitchell, S. W. Jenckes, J. A Dresser, Hon. C. C. Colby, and A. N. Thompson (of Stanstead), John Bene, S. L. Spafford, A. N. Thompson, J. R. Woodward, and the Chairman, and report at a later meeting of the section.

The meeting adjourned at 11.30.

NOVA SCOTIA SECTION.

The meeting which was to have been held at Sydney on 13th instant was unavoidably postponed, the Secretary, who had gone as far as Levis on his way to the meeting, being recalled to Ottawa on an urgent personal matter. At a meeting of the Council of the Institute it was decided to hold this meeting later on in the year.

DOMINION COAL COMPANY.

The following is the report to the shareholders, submitted on the 17th instant :—

The sales of the Company during the past year have increased to the extent of over 600,000 tons, and it is expected that a satisfactory increase in output will be maintained during the coming year.

OUTPUT IN TONS.

YEARS ENDING FEBRUARY 28TH.

1895— 884,000	1897— 1,221,471	1899— 1,295,543	1901— 2,044,877
1896— 1,169,785	1898— 1,061,669	1900— 1,739,374	1902— 2,651,263

Owing to this increase in the business of the company, as shown by the above statement, it has been necessary to add largely to the mining plant and machinery; railway and equipment; shipping piers; houses for employees, etc; and during the past year nearly one million dollars have been spent on such extensions and improvements

Since the last annual meeting, arrangements for the supply of rolling stock, and for the erection of workmen's houses, have been completed with the Dominion Rolling Stock Company and the Cape Breton Real Estate Company, respectively, by which the company has acquired the necessary rolling stock and houses for its business, the expenditure upon these being provided for by terminable debentures, liquidated by equal monthly payments extending over a period of ten years, in which capital and interest at a reasonable rate are included. These payments are met by the earnings of these properties themselves, and at the end of the period they will become the absolute property of the Coal Company, free from encumbrance.

The company has succeeded during the past year in placing its coal in the European markets, where it is well thought of, and when Colliery Dominion No. 2 is completed, the company will have a market across the Atlantic for any surplus that it may not be able to place among its customers in Canada, Newfoundland, and the United States.

The company's properties at present comprise the following :—

COAL AREAS.

The coal areas of the company have an extent of 140 square miles, and the known seams over three feet in thickness are estimated to contain 1,500 million tons.

COLLIERIES.

There are six collieries at present in operation, known as Dominion No. 1, Dominion No. 2, Dominion No. 3, Caledonia, Reserve, and International. These collieries have been equipped with the most modern machinery for mining, hauling, and hoisting the coal. They are thoroughly ventilated. The bankheads, engine and boiler houses, and pit bottoms of the first four are electric lighted.

DOMINION NO 1.—This colliery has a capacity of 70,000 tons per month. The coal seam is known as the Phalen, and is eight feet thick. The coal shaft is 157 feet deep. The mining is done with puncher type coal cutting machines, driven by compressed air; endless wire ropes being used in haulage. The electric locomotive and haulage in the pit has a capacity of 50 tons per trip. A large duplex pump has been installed in the pit for pumping the mine water to the surface.

DOMINION NO. 2.—The work of opening this colliery was begun in 1899, and it is now nearing completion. The present capacity is 30,000 tons per month. It is expected that by the close of the year the capacity will be increased to 75,000 tons per month, and the ultimate capacity will be 150,000 tons per month. Two coal seams are worked, the Phalen, 7½ feet thick, and the Harbor, 5 feet 8 inches thick. The shaft is 408 feet deep to the Harbor seam, and 900 feet to the Phalen seam. The mining is done by puncher type coal cutting machines and hand picks. The mine tubs have a capacity of two tons each. The coal is weighed and tipped at pit bottom into a tank hoist of six ton capacity, which dumps automatically. It is the intention to install compressed air haulage in the pit bottom to handle the coal to the shaft. The steel bankhead, now being erected will be 125 feet high.

DOMINION NO. 3.—The capacity of this colliery is 35,000 tons per month The coal seam worked is the Phalen, and is eight feet thick. The mining is done partly by hand and partly by puncher type coal cutting machines, driven by compressed air. The coal is handled by endless rope haulage.

CALEDONIA COLLIERY.—This colliery has a capacity of 70,000 tons per month. The coal seam is the Phalen, eight feet thick. It is mined partly by hand and partly by puncher type coal cutting machines. Endless wire ropes are used for haulage. The shaft is 182 feet deep.

RESERVE COLLIERY.—This mine has a capacity of 75,000 tons per month. The coal seam mined is the Phalen, eight feet thick. The work is done partly by hand and partly by puncher coal cutting machines, with endless wire rope haulage. There are basket elevators for handling slack coal.

INTERNATIONAL COLLIERY.—This colliery has a capacity of 17,000 tons per month. The Harbor seam, six feet thick, is mined by hand picks. Endless rope and tail rope haulage.

The company has also a complete coal washing plant, capable of washing about 2,000 tons per day; extensively equipped repair shops at Glace Bay; a foundry, car shops, etc.

The Sydney and Louisburg railway, which is owned by the company, extends from Sydney to Louisburg, making connections with all the mines —40 miles of main line and 57 miles of sidings. The railway is solidly constructed with 80lb. steel rails; the bridges are of steel with stone abutments, and the grades and curves are light.

The rolling stock consists of 19 locomotives, 1355 flat coal cars, and 12 passenger and service cars.

SHIPPING PIERS.

There are two piers at Sydney, having each a capacity of 10,000 tons in 24 hours. At the Louisburg terminus there are also two piers—one a high level, the other a low level pier. The high level pier is equipped with the Robins belt conveyor and slack pocket, with capacity of discharging 750 tons of coal per hour.

STEAMSHIPS.

The company owns five steamships, two tugs, and five barges. During the past winter the equipment has been thoroughly overhauled, and the "Bonavista," the company's passenger steamer, fitted up with electric light.

DWELLINGS.

The company has at present 1200 substantially built houses rented to workmen; and also has its own stores at Glace Bay and six subsidiary stores at different collieries.

EARNINGS.

During the past year the surplus earnings of the company amounted to $937,681.44, and there has also been deposited in addition $122,939.55 in the sinking fund for the redemption of the company's bonds. This latter amount, together with interest on $125,000 reserve sinking fund, is sufficient to retire $115,000 of these bonds, by which the bonded indebtedness will be reduced to $2,589,500.00.

Submitted on behalf of the Directors,

JAMES ROSS, *Vice-President.*

Montreal, 12th June, 1902.

NINTH ANNUAL REPORT of the DOMINION COAL COMPANY, LIMITED, For the year ending February 28th, 1902, as compared with year ending February 28th 1901.

	FOR YEAR ENDING FEB 28, 1901.		FOR YEAR ENDING FEB. 28, 1902.	
Net Proceeds from Sale of Coal and Net Income from Steamships, Railroads, Stores, and Real Estate	.....	$687,294.88	.....	$1,551,880.99
Less—				
Interest on Bonds	$167,670.00	....	$162,240.00	.....
Dividend on Preferred Stock	213,333.33	.....	240,000 00	.....
Miscellaneous Interest and Premiums on Bonds retired	47,343.16	428,351 49	91,727.85	493,967.85
Surp'us of Net Income		258,943 39	.....	1 057,913 14
Add—				
Preferred Stock Premiums	.....	100,000.00	.....	.....
Total	.....	358,943.39	.....	.....
Less Sinking Fund	.....	95,743.30	.....	120,231.70
		263,200.09	.....	
Charged off	.....	104,018.90	.....	.....
Balance to General Surplus	....	159 181.19	.....	937,681.44
BALANCES.				
ASSETS—				
Property Account as per last Report	20,249,721.99	....	21,333,163.86	.....
Less—				
Written off for Depreciation	51,930.06	.....	122,374 77	.....
	20,197,791.93	.....	21,21 0789.09	.....
Add Capital Expenditure during year	1,135,371.93	21,333,163.86	960,344.35	22,171,133.44
Cash in Banks and Offices	.....	140,324.65	.....	327,355.36
A. Accounts Receivable	.....	71,345.86	.....	632,344.29
B. Coal on hand	.....	555,250 07	.....	196,289.80
New Supplies in Stores and Warehouses	.....	445,327.15	.....	518,114.74
Insurance paid in Advance	.....	4 498.73	.....	25,451.41
Interest paid in Advance	.....	11 511.34	....	2 308 05
Steamship Hire paid in Advance	.....	7,895.21	.....	14,072.79
Cash in New England Trust Co. for Sinking Fund	.....	136,402.08	.....	134,547.05
		22,705,718.95		24,021,616.93
LIABILITIES:				
Capital Stock, Common	15,000,000.00	.....	15,000,000.00	.....
" " Preferred	3,000,000.00	.....	3,000,000.00	.....
First Mortgage Bonds	2 801,500.00	.....	2 704,500 00	.....
C. Hochelaga Mortgage	.....	.....	22,0 0.00	.....
D. Cape Breton Real Estate Debentures	.....	.....	289 391.75	.....
D. Dominion Rolling Stock Debentures	.....	20,801,500 co	289,391.75	21,305,283.50
Accrued Dividend Jan'y-Feb'y	40,000.00	.....	40,000 00	.....
Unpaid Royalty	87,616.62	.....	37,589.50	.....
Accounts Payable	78,758.59	.....	161,941.50	.....
Notes Payable	1,105,000.00	1,311,375.21	840,000.00	1,079,531.00
Special Reserve	.....	.....	.....	106,277.25
SURPLUS—				
Balance from previous years	433,662 55	.....	592,843.74	.....
For current year	159.181.19	592,843 74	937,681.44	1,530,525.18
		22,705,718.95		24,021 616.93

A. For year ending Feb. 28th, 1901, "A" did not include Accounts Receivable at Agencies

B. These were included in "B," as Coal on hand and balance due from Agents.

C. The Hochelaga mortgage dates since 1894, but was not entered on the books of the company until the present year.

D. This liability was incurred previous to year ending Feb. 28th, 1901, and was for the purpose of providing for new miners' dwellings and additional rolling stock, as referred to in Directors' Report.

SINKING FUND, MAY 1, 1902.

$11,800 Unites States 4s, costing	$124,817.62	
Cash for retirement of Bonds	128,644.31	
Cash under Article IV	4,144.25	
Accrued interest on U.S. 4s	372.67	
		$257,978.85
For		
Reserve Sinking Fund	$125,000.00	
Retirement of Bonds, etc	132,978.85	
		$257,978.85
Balance Reserve Sinking Fund	$125,000.00	

The Crystal Gold Mine for Sale.

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Full particulars can be obtained from the undersigned.

WM. R. WHITE,
Liquidator of The Crystal Gold Mining Co. of Rathbun, Limited.

Dated PEMBROKE, June 26th, 1902.

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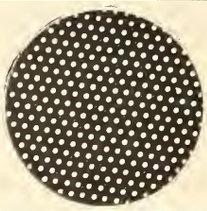
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CANADIAN MINING INSTITUTE.

BRITISH COLUMBIA SECTION.

A PUBLIC MEETING of Mine Owners, Mine Managers, Mining Engineers, Assayers, and all who may be interested in promoting the welfare of the profession and industry of mining in British Columbia, will be held in the **CITY OF NELSON**, on

Tuesday, 9th September, 1902

(AFTERNOON AND EVENING SESSIONS)

for the purpose of completing the British Columbia Section of the Institutel
A programme of papers of interest to mining men in the Province wil. be submitted for discussion.

B. T. A. BELL, *General Secretary.* CHARLES FERGIE, *President.* R. R. HEDLEY, *Chairman.*

IN PREPARATION

TWELFTH EDITION

The Canadian Mining Manual

FOR 1902

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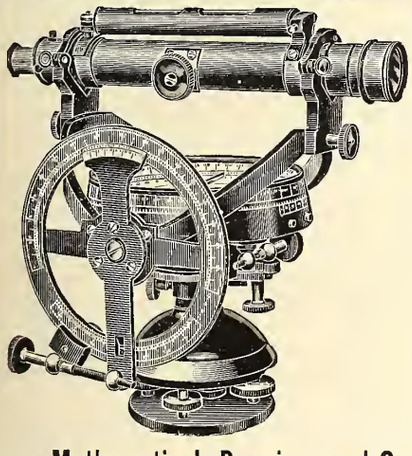
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   (*h*) Biology and Public Health.
3. COURSES IN CHEMISTRY, MINERALOGY AND GEOLOGY for degrees of Bachelor of Arts (B.A.) and Master of Arts (M.A.

For further information see the Calendar of Queen's University.

4. POST-GRADUATE COURSE FOR THE DEGREE OF Doctor of Science (D.Sc.)

For further information see the Calendar of Queen's University.

Next Session begins October 1st, 1902.

MATRICULATION EXAMINATIONS HELD AT QUEEN'S UNIVERSITY, SEPTEMBER 16TH.

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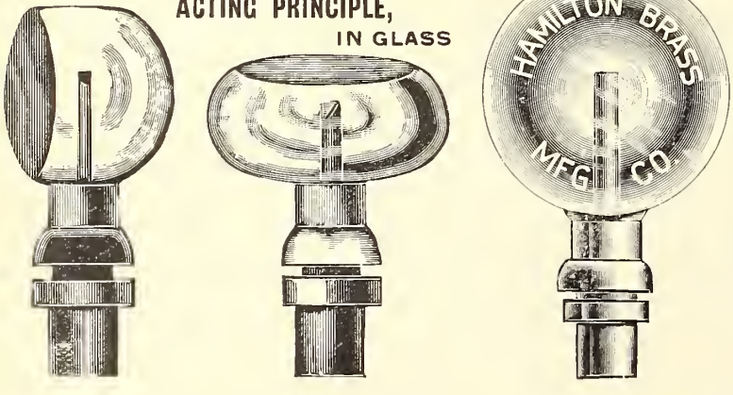
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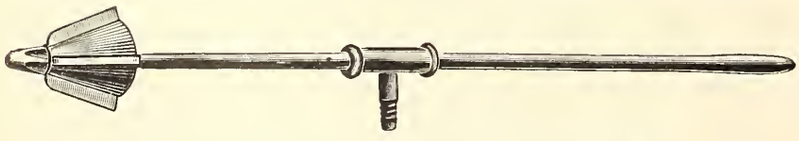
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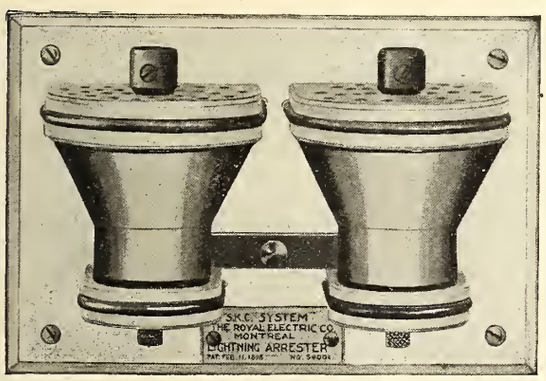
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GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents anuually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

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ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at the mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order in Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's Certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end on the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 an acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee $5.00 renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed in the river below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent. on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River and Hill Claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer Claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim, and each person in his or its employment, except house servants, must hold a Free Miner's Certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of five per cent charged on the gross output of the claim, with the exception of an annual exemption of $5,000 00.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek or gulch, but the same miner may hold any number of claims by purchase, and Free Miners, not exceeding ten in number, may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch or river, by giving notice and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00 and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette.*

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, and a royalty of five per cent. on the gross output, less an annual exemption of $25,000.00 are charged. Operations must be commenced within one year from the date of the lease, and not less than $5,000 must be expended annually. The lease excludes all base metals, quartz and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,

Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite: copper in sulphide and native form; gold, mostly in free milling quartz; silver, native and sulphides; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc, apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

ELEVATORS-CONVEYORS



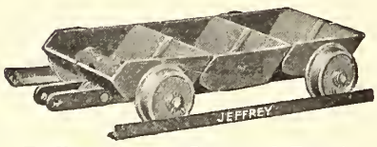
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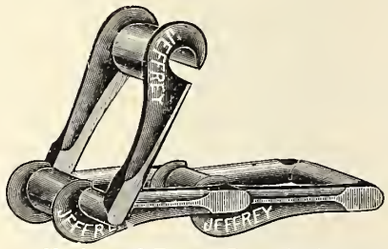


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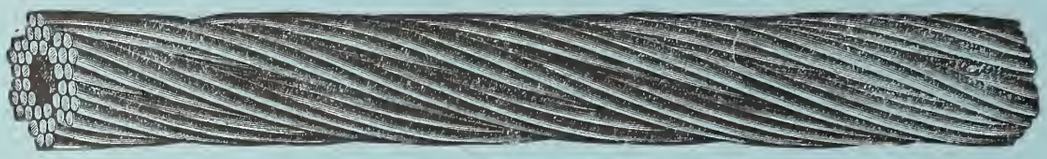
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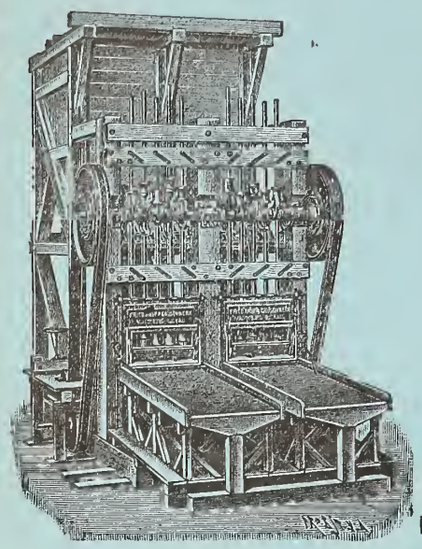
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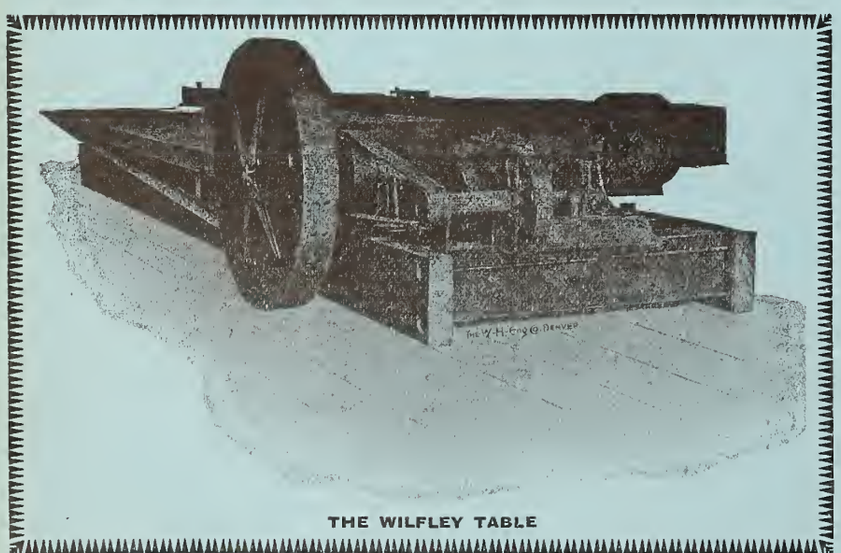
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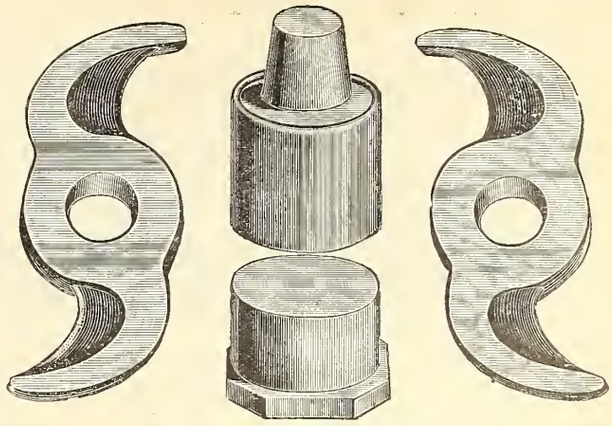
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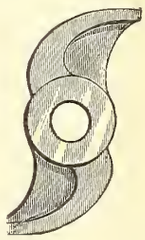


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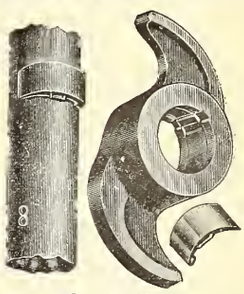


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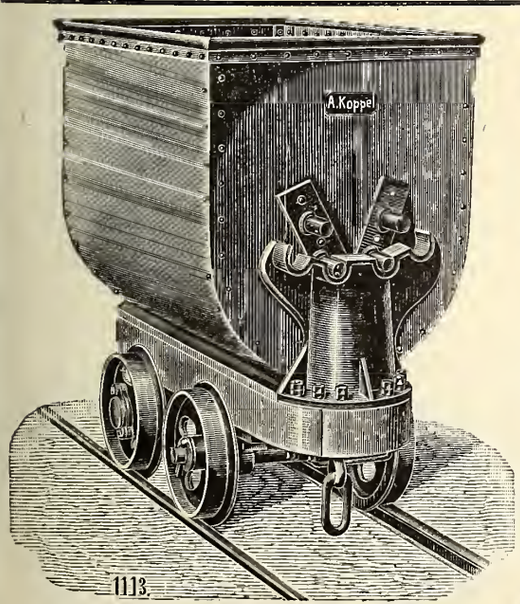


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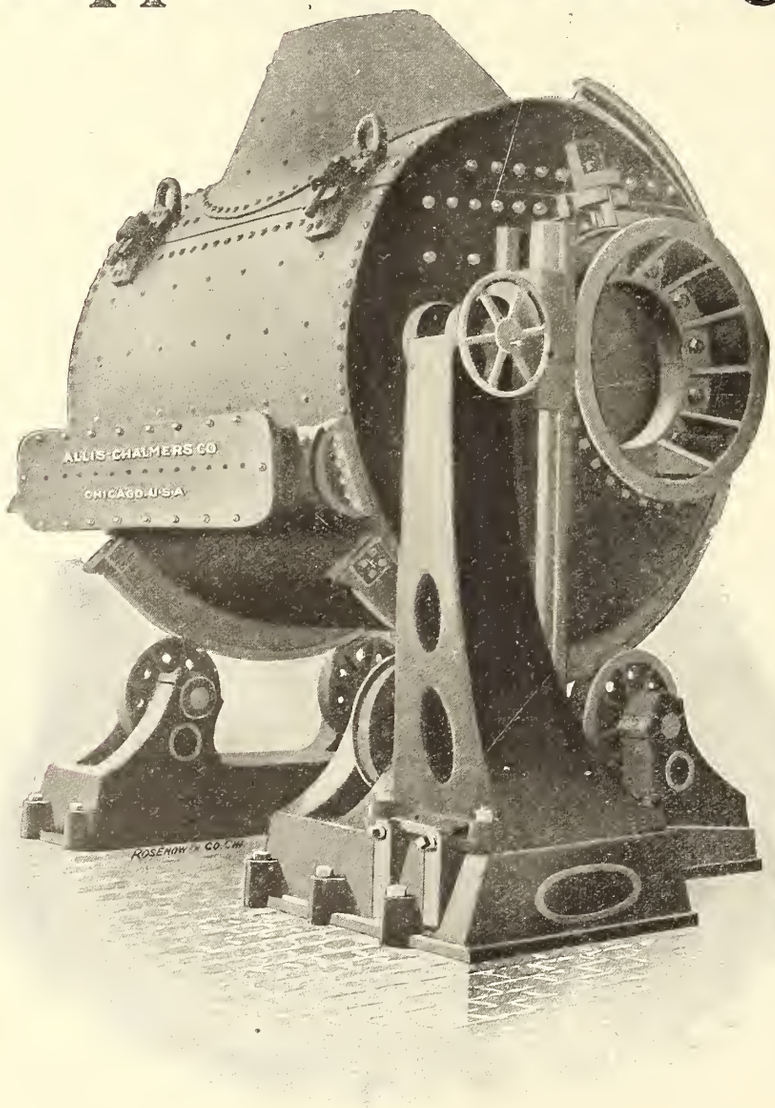
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The above illustration shows our Standard "Trough" or Bisbee Converter. The shell, heads and nose are made of heavy steel plate; the riding-ring of cast steel; the gear wheel is a full circle faced and bolted to a faced circular casting riveted to the head. The rack is hinged at the bottom and held in place by a cam. The wind-box is furnished with Dyblie valves.

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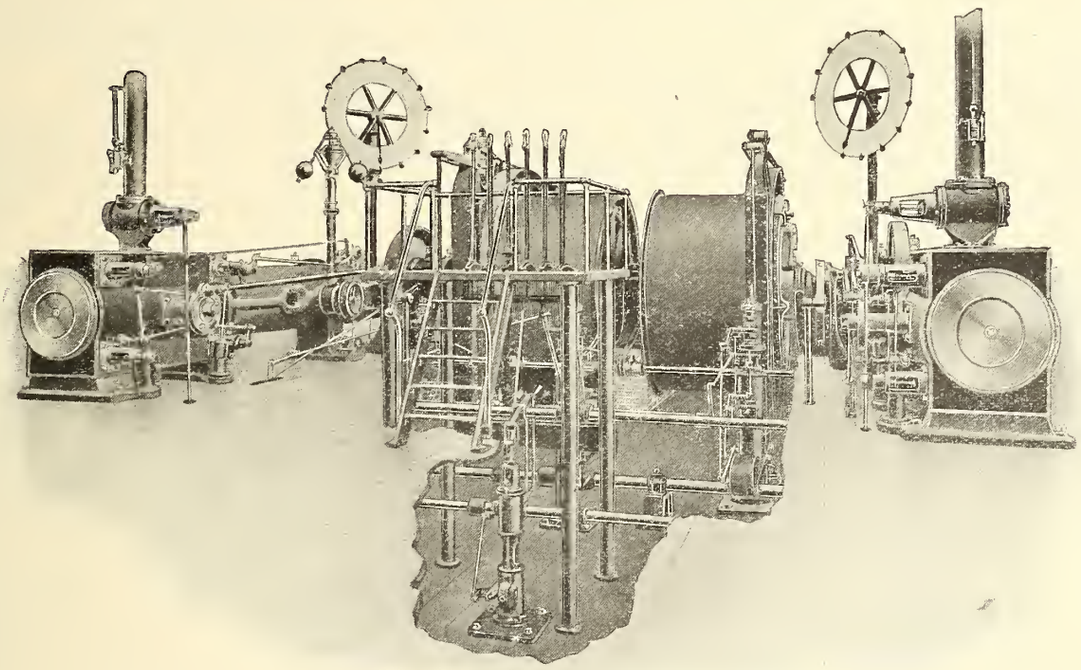
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(STANDARD AND SPECIAL DESIGN)



Description of Hoisting Engine built for the Le Roi Mining Company

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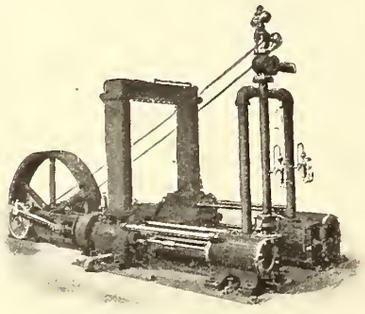
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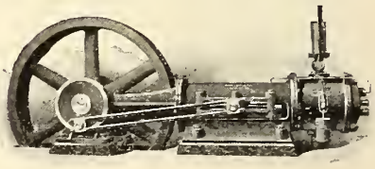
AIR COMPRESSORS



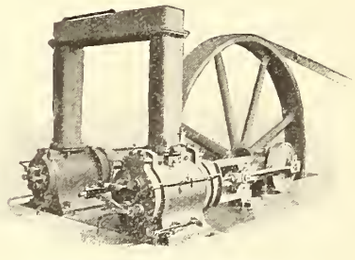
Class B-D Compressor
[Air Cylinders next to Frame]



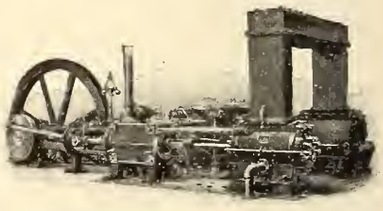
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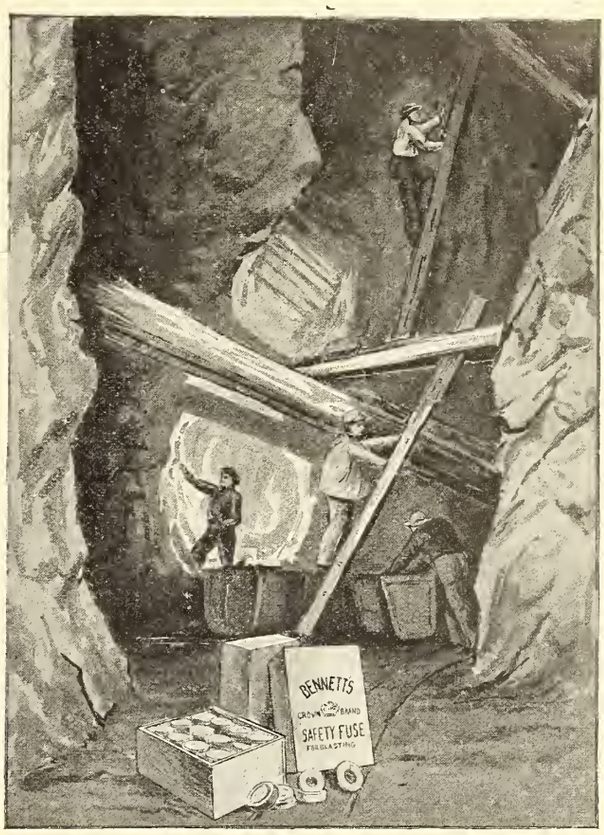
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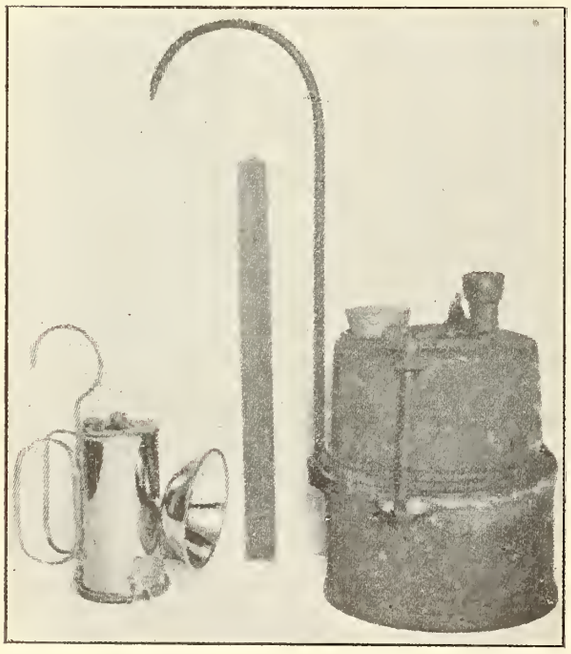
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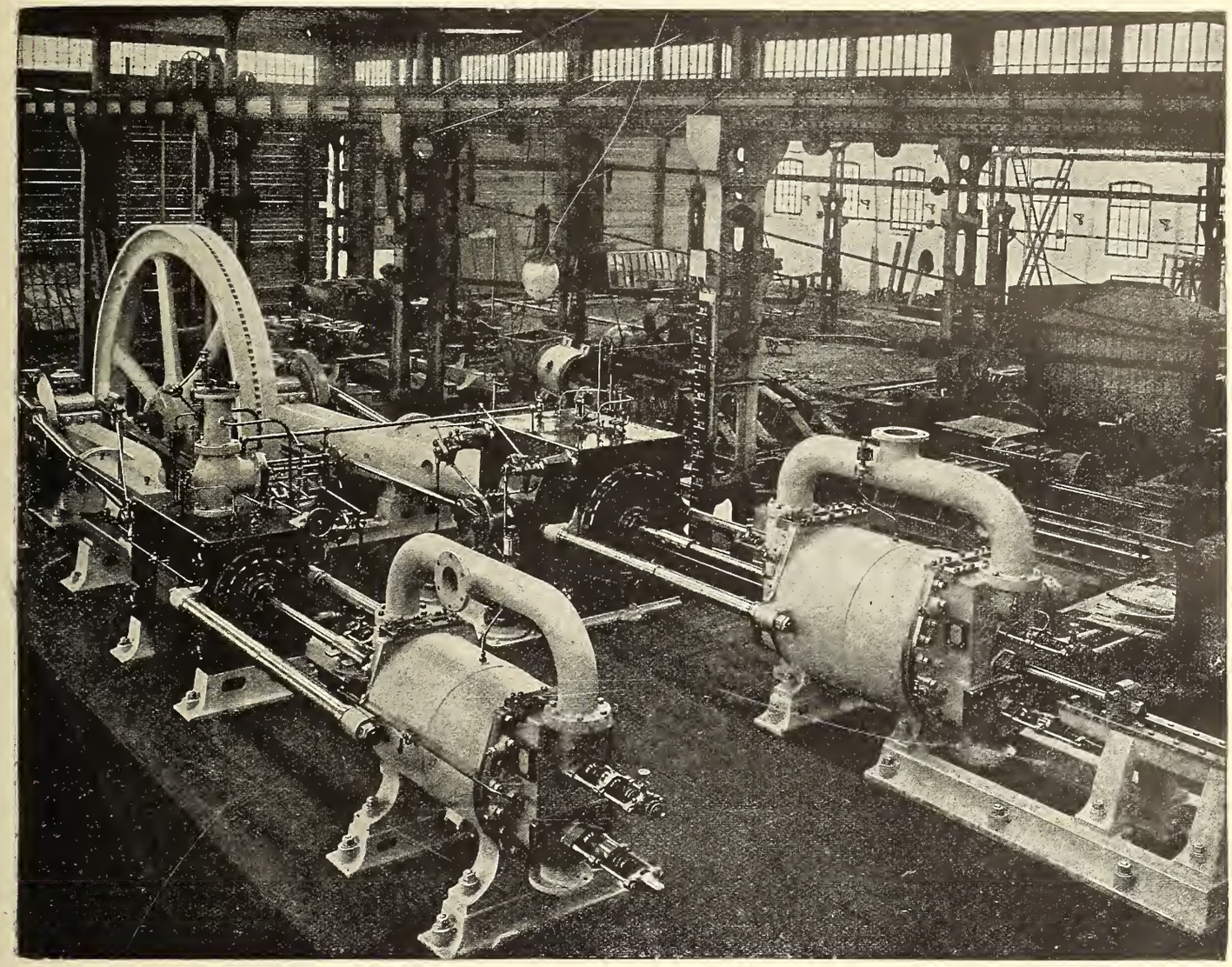
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BLACKWALL TUNNEL WORKS, EAST GREENWICH, S.E.
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DEAR SIRS,—We are pleased to confirm what we told you verbally the other day, viz: that we consider the Air Cylinders and Valves of your Compressors to be the best for such work as we have been carrying out on the above Contract.

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We are, Dear Sirs, Yours faithfully. (Signed) pro S. PEARSON & SON, E. W. MOIR.

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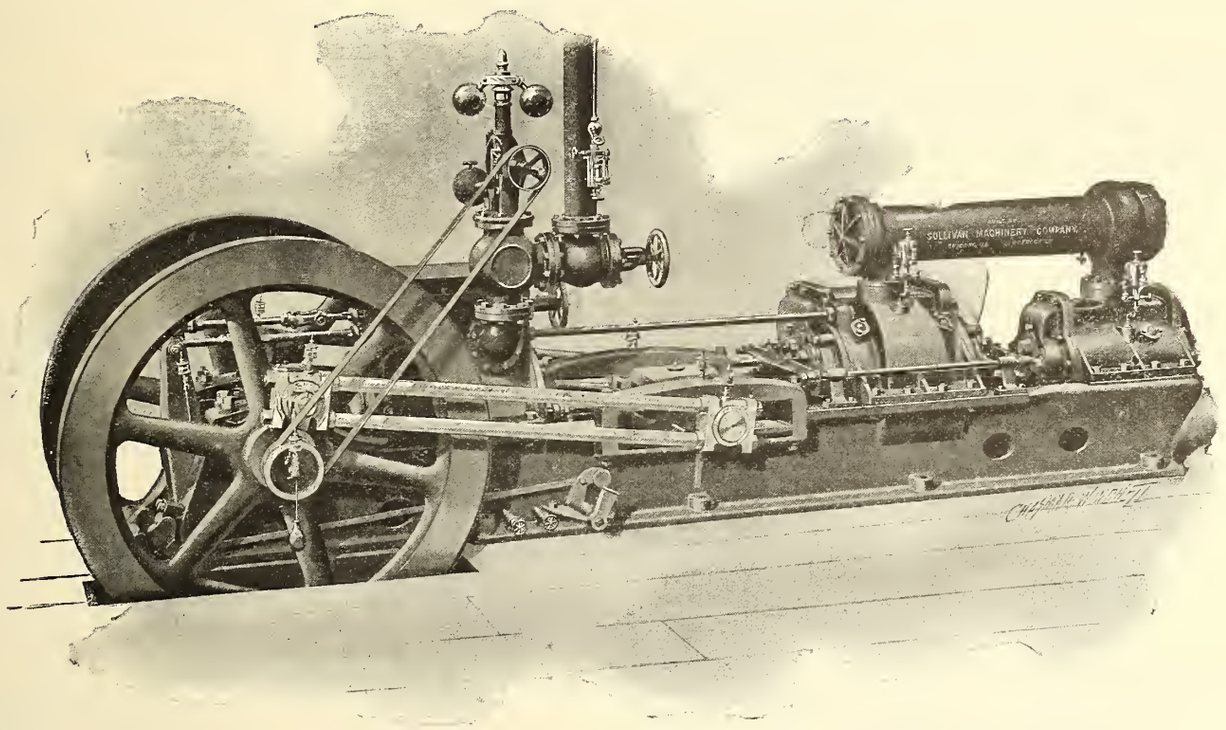
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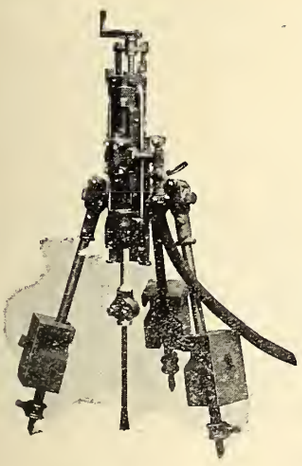
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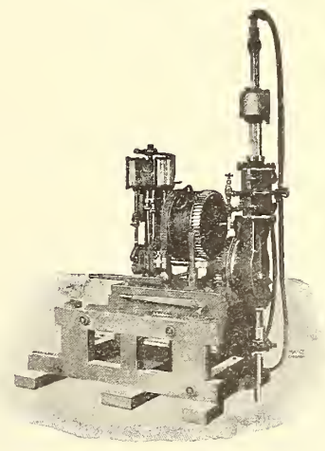


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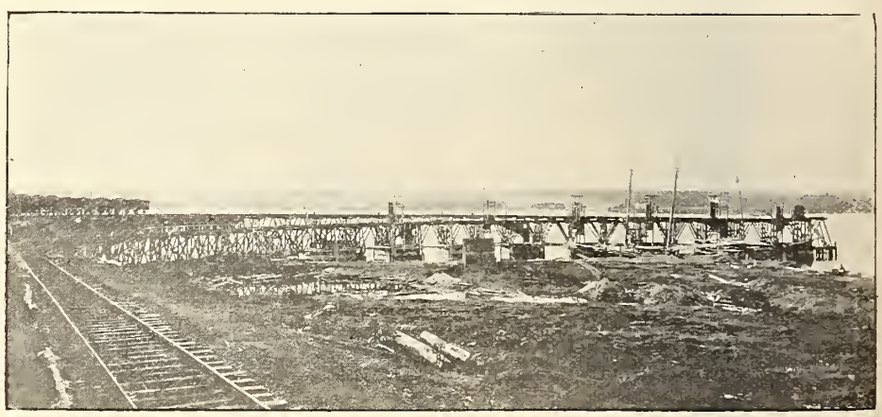
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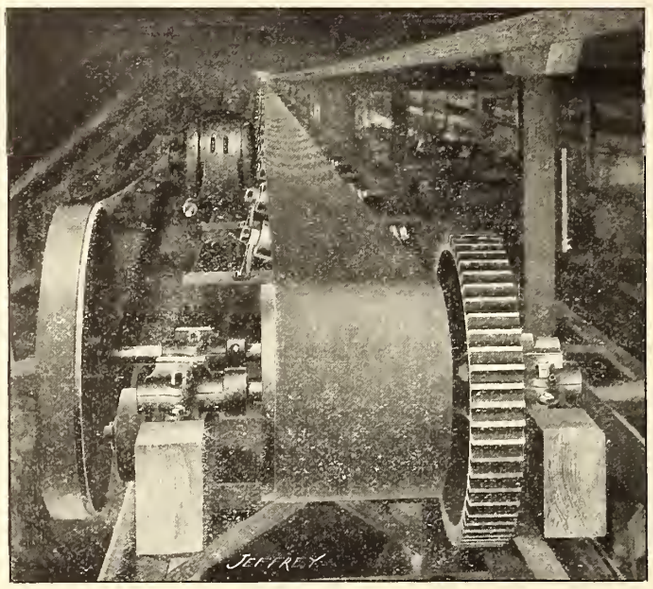
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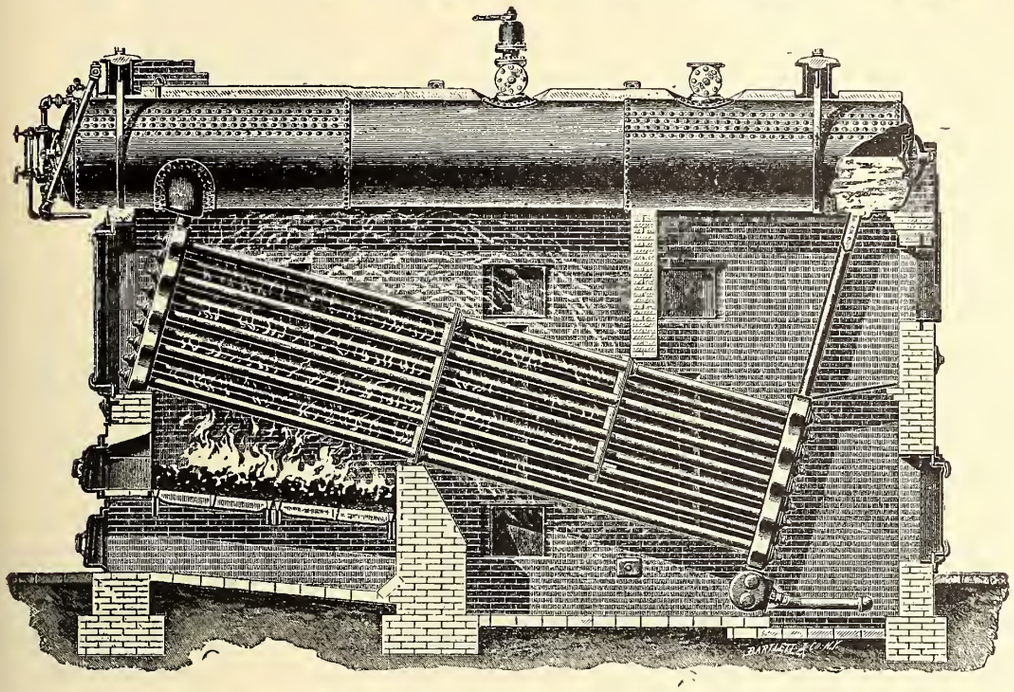
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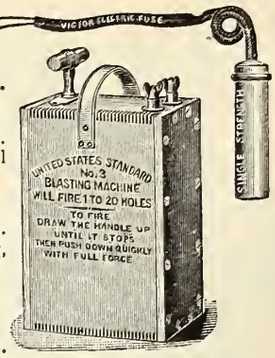
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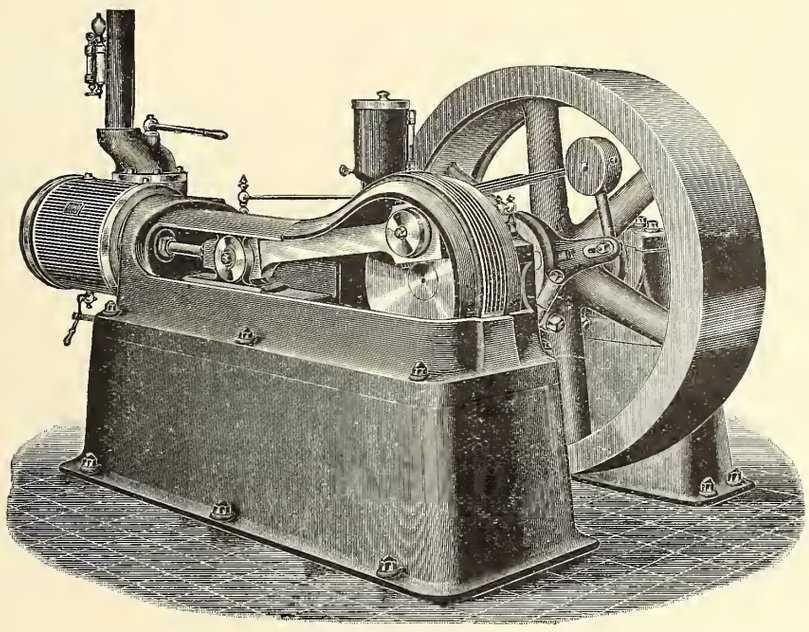
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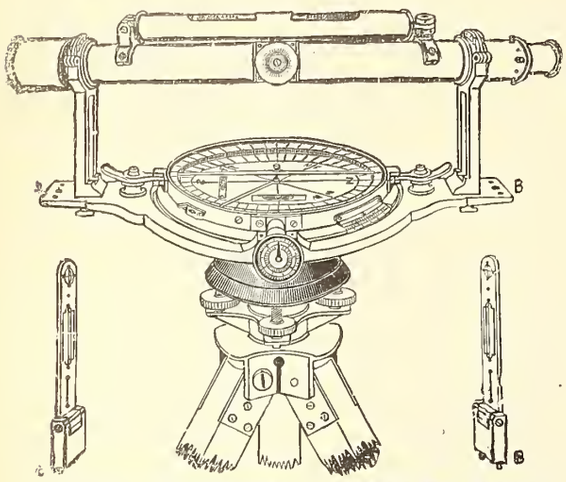
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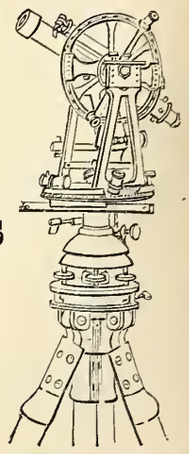
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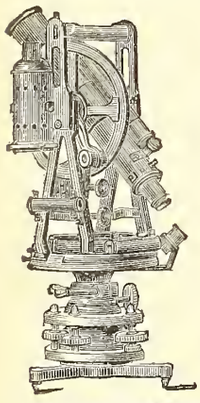
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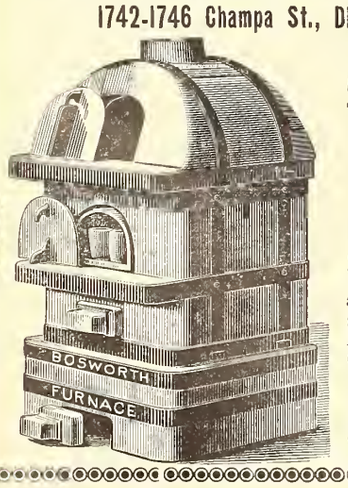
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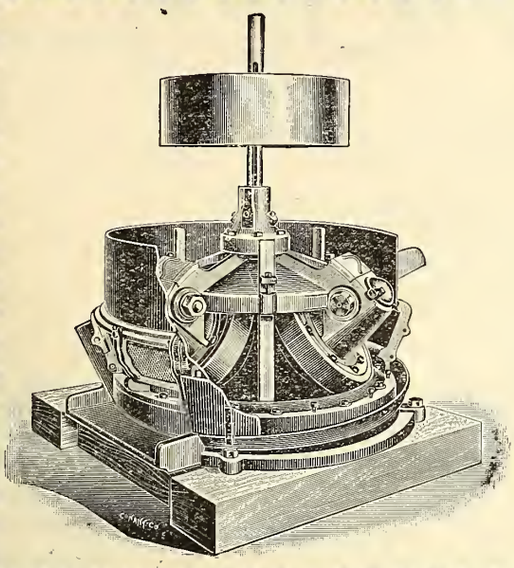
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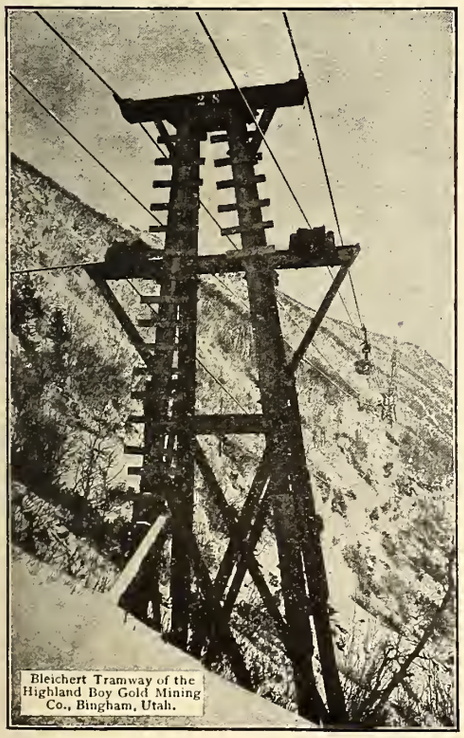
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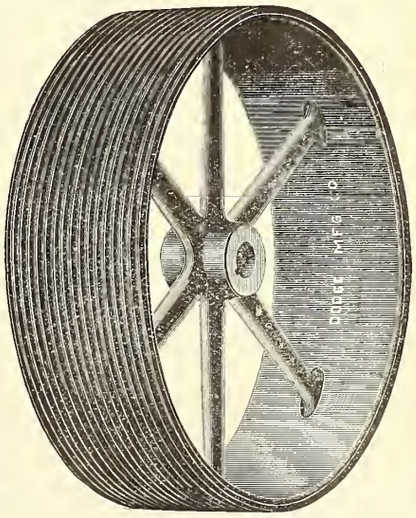
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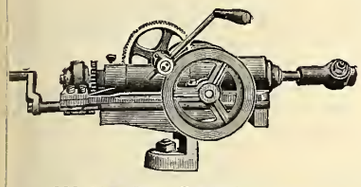
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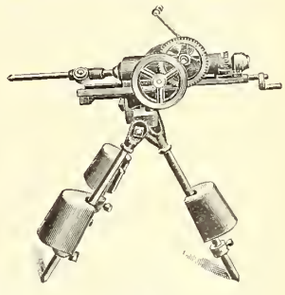
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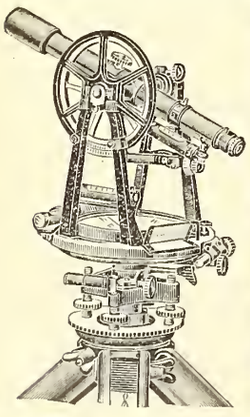
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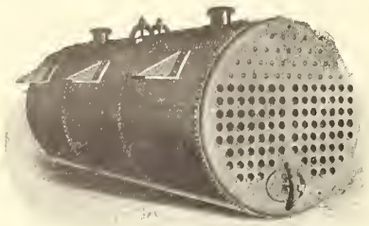
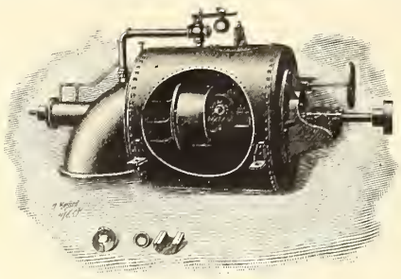
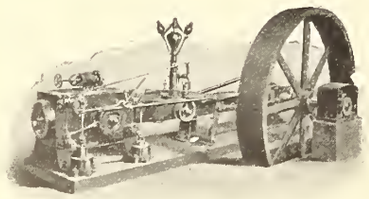
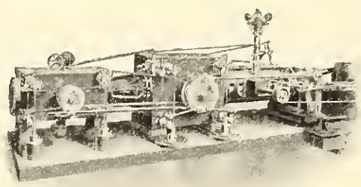
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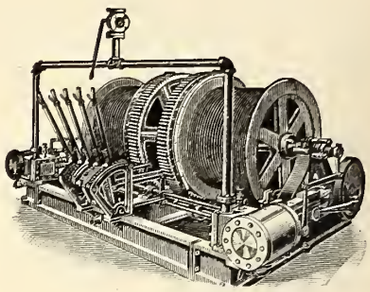
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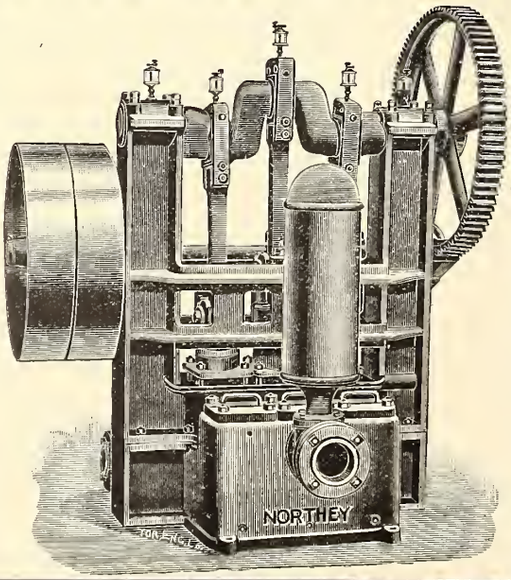
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The Nickel Outlook.

The consolidation of several of the great nickel producing companies has led to the reduction of the working force at Copper Cliff and the various properties held by the Canadian Copper Company. It is said that this is only temporary, and has been necessitated by the reorganization of the business under the new *regime*. Whatever the cause, about eight hundred men have been laid off. Fortunately for them, mining and smelting operations are at present so active in Ontario that little difficulty has been experienced in securing employment.

Three factors may be expected to determine the direction in which the combined companies will move in supplying the nickel market, which, it should always be remembered, is at present a limited one. These factors are (1) the supply of ore, (2) the process of reduction, and (3) the government regulations.

The supply of ore in the Sudbury district seems to be very large. The Copper Cliff, the original producer, is still being worked. Ore is being taken out from several other deposits in the neighborhood of the smelters. The Stobie is at present idle, not, we are informed, from any lack of ore, but because ore of higher grade can be easily obtained. The Froode is producing and shows no signs of a falling off. But, while development and production seem to be going on somewhat slowly elsewhere, the work at the Creighton is being pushed vigorously. This deposit seems to be the largest in the district, and is at least up to the average in nickel content. The immense body of ore now visible in the open cast is sufficient in itself to supply the smelters for a long time to come. The mines of the other companies should be taken into account in estimating the factor of supply of ore. The Lake Superior Power Co. is working the Gertrude, two miles west of the Creighton, and the ore body there is stated to be large. The Elsie, belonging to the same company, is being developed. The Mond Nickel Company are getting plenty of ore from the Victoria, and are now developing the North Star, which lies in the same range as the Gertrude and the Creighton. The old Worthington has been pumped out and is being further developed. All the indications point to an unlimited supply of ore in the district. The Copper Cliff at a depth of over 1,000 feet is still producing ore, and this is presumably an index of what may be expected of a fair proportion of the other mines. At present, the ore supply is so plentiful that only the richer ore bodies are being worked. Should these fail, the smelters could doubtless be supplied by concentration of the leaner ores.

The process is a more difficult and complicated factor to estimate. In the first place, after all the experimenting, newspaper interviews and vaunting of new processes, the old roasting and smelting process as practised at Copper Cliff is the only one now in use. There may be modifications, but the roast heap, the smelter, the matte, and the Bessemerizer are to the fore wherever the ore is being reduced on a large scale. We do not mean to imply that there has been no result from all the experimenting. Far from it; but so far the results have only accentuated the complexity of our problem, and the fact that much remains to be done before the present process, cumbrous and lengthy as it is, can be replaced by a neater and less expensive one. A number of investigators have been working on magnetic separation. It has been shown to be possible to separate the copper ore from the nickeliferous pyrrhotite, and the latter into a weakly magnetic part carrying the greater part of the nickel and having a composition approximating to that of pentlandite, and a more strongly magnetic part containing little nickel. To effect this, the ore must be ground and passed through several magnetic separators with magnetic fields of different intensities. Two difficulties arise,—first, the devising of magnetic separators of practicable efficiency and capacity, and secondly the prevention of waste of the high-grade fines in the subsequent smelting operations. Experience with ground matte has already shown that the waste as flue-dust may be very serious where the blast furnace is used. Briquetting would prevent this only in part, as the briquettes are easily pulverized. Nothing is heard of the success or otherwise of the Mond nickel process. It has been stated that the only serious difficulty met with in the extraction of the nickel on the large scale as nickel carbonyl has been the deterioration of the apparatus owing to the considerable variations of temperature; but a mechanical difficulty like that is certain to be overcome, if it indeed exists. In the meantime the production of matte at Victoria mines goes on. The direct production of nickel steel from selected pyrrhotite roasted sweet, briquetted and mixed with iron ore does not seem to have been effected at Sault Ste. Marie, where experiments in this direction have been carried on. One of the difficulties in such a process is to obtain pyrrhotite low enough in copper, although we are reliably informed that a small percentage of copper is not detrimental to the quality of steel. This process is an attractive one, too, because of its allowing the sulphur dioxide to be utilized, thus avoiding the nuisance of the roast heaps, and at the same time giving valuable by-products. However, if it came into general use, a difficulty might arise in finding a market for these by products, viz., sulphuric acid and sulphites. Then, too, a process could hardly receive favorable consideration unless it provided, at some stage, for saving the gold, platinum, palladium, and other

precious metals found to a greater or less extent in these ores. On the whole it would seem that the metallurgical treatment of our copper-nickel ores must necessarily be a complicated one. Nevertheless it may be possible to so improve and modify the processes at present used as to reduce the cost of production of nickel and thus extend its use.

The question of government regulations is a difficult one. While the International Nickel Company now controls about sixty per cent. of the total output of nickel, it must be remembered that the Société Le Nickel, which supplies nearly the whole of the remaining forty per cent., is an independent company. On the one hand it should be the aim of Ontario, as of every country, to manufacture its raw materials as far as possible before exporting them; but, on the other hand, discretion forbids us to unduly hamper the development of what is admittedly a difficult metallurgical problem.

The Selection of Crow's Nest Coal Lands.

The Minister of the Interior is to be congratulated on having finally made an excellent selection of coal lands, for although, as the coal company have appropriated one by one the most valuable locations and the chances of a good selection seemed to be gradually diminishing, at last a stand was made against this grabbing policy, just in time to prevent Morrissey Creek following the other possible points of vantage.

The selection finally made is the one we have openly advocated for two years past, and is the only possible one to place the Government in possession of 50,000 acres of coal land "of equal value to the other coal lands," as prescribed by the Statute. The whole of the outcrops on Coal Creek and Marten Creek are covered by these sections, and but for a surveyor's error Morrissey would have been in the same position, for, feeling secure in the possession of that location, the coal company prevailed on the Government to allow them to settle on Michel, thinking thereby to cover every available outcrop. This was permitted in 1899, but last year it was discovered that the south-west corner stake of the freehold sections at Morrissey fell short of the creek on the north side by a quarter of a mile, thus furnishing the Government with an opportunity to slip in and avail themselves of what is really the best location in the Pass.

The Government take the south side of Morrissey as far as Lodge Pole, thence east. following the course of the latter creek in line to the eastern boundary, between British Columbia and Alberta. Starting again, from a point at the junction of Morrissey and a branch creek, they draw a line due north, skirting the eastern boundary of the coal company's freehold and cutting off the coal to the deep until they reach the Marten Creek freehold. This gives the Government the best undisturbed area in the Basin, as they secure coal where it is more solid, free from faults, and regular in quality. Analyses of the Fernie coals show a range of fixed carbon from 64 to 74 per cent., and ash from 5 to 10. Morrissey tests made last season yielded from 74 to 79 per cent. of fixed carbon, and from 2 to 4 of ash, the coal being both cleaner and firmer and yielding a higher grade coke.

When the official statement announcing this selection was made, —whether authorized or not we cannot say—it was declared that the Government had thus secured a property which would "pay the Dominion debt." This would seem to indicate on their part the wise intention to utilize their valuable asset and raises the one important question as to what should be done with this property.

First of all, it belongs to the country, and should be used for the public good. It is obvious that it can never pay the Dominion debt nor be of any service if it is simply to remain locked up. The same objection would hold good if it fell into the hands of the Crow's Nest Pass Coal Co., or the C.P.R., who have more than sufficient areas of their own, and who, by reason of their other interests, could not furnish any effective competition.

Is competition needed? Undoubtedly, both on the ground of supply and price. The C.N.P.C. Co. have been in operation nearly five years, and have only now reached the comparatively insignificant output of 2000 tons a day, although they have occupied five separate sites, the most favorable they could select. Two on Michel, two on coal, and one on Morrissey, and are operating six mines. They commenced work at Michel in 1898, on the outcrops of the seams, and have not yet reached 500 tons a day. A year ago they opened up five or seams at Morrissey of good quality and easy of access; up to date they have not commenced to ship coal. Meanwhile, during the major part of last year, there was a shortage of both coal and coke at British Columbia smelters. No doubt this will be remedied in the future, but the recent deplorable accident, followed as it has been by an unfortunate strike, only tends to show how nearly the whole supply may be cut off at a moment's notice, and the Provincial industries closed down for want of fuel. Under the most favorable conditions this accident involves two months' cessation of coal production, and there is no guarantee that the sad experience may not be repeated.

As to price, we have always been opposed to arbitrary restrictions, holding that the consumer should pay just what the article required will fetch in the open market. In the present instance, however, the absence of competition creates a monopoly, under which Canadian customers are still paying 50 cents a ton more for coal and $1 per ton more for coke than they would if there was fair competition in the Pass.

No doubt the Government intended to protect the consumer by fixing $2 as the maximum selling price, but subsequent experience has shown that it was a mistaken kindness, as Blairmore coal, equally good for steam purposes, sells for $1 50. The price of coke was not fixed in the charter, but we maintain that the $2 rate for raw coal was intended to govern it. Be that as it may, the lowest figure at which the C.N.P.C. Co. have sold coke to date is $4 at the ovens.

Now is there any urgent necessity for cheaper fuel and especially coke? In view of the constantly accumulating evidence as to the real value of the low grade ores of B.C., who can doubt it? Look at the whole of the Boundary district on which the future of southern B.C. so much depends, with an ore averaging little, if any, above $4.00. Look at the Rossland Camp. How are the mighty fallen? Le Roi under $10, Centre Star and War Eagle certainly no higher. The fact is that in all the large mines rich pockets and pay chutes near the surface have been practically exhausted and the lower levels have revealed lower values; the theory that the veins would get richer as they went down has been effectually exploded and only by the strictest economy in mining and smelting can our camps continue to operate. No one can claim that freight and treatment charges are high at any Canadian smelter. We have it on the highest authority that the Granby cost is under $2, and the recent contract made by the Centre Star and War Eagle Co. with the Canadian Smelter at $4.50 for freight and treatment must be regarded as very low. All this shews the severity of the crisis which has been reached and points to the absolute necessity for the cheapest fuel obtainable.

How can this best be secured? By leasing 10,000 acres of the Government coal lands to disinterested parties, having no possible connection with either of the corporations mentioned, with such restrictions as would involve the forfeiture of the lease if its conditions were violated, This could not be compassed by a sale, as control would cease, and, however high a price might be paid, cheap fuel

would not be ensured. A twenty years' lease, with a royalty to the Dominion Government of 10 cents a ton, and an initial payment of $1,000,000 for the lease, would result in an annual income of $100,000, and yet retain Government control, and for such a lease at least a dozen applicants would be forthcoming Only in this way can effective competition and cheap fuel be secured, and any satisfactory, because permanent, contribution made to the Dominion exchequer, and we commend it to the serious and early consideration of the Government.

CORRESPONDENCE.

The Electrolytic Production of Metals, with Special Reference to Copper and Nickel.

SIR,—Again referring to Mr. Ulke's comments upon my paper, permit me to say:—

1st. I have no alterations to make concerning my communication of the 4th inst. and must refute the assertion as to my unscientific and illogical character of the classification of electro-metallurgy. In fact other metallurgists go still further.

Dr. Carl Schnabel, in his eminent work upon metallurgy in general subdivides the production of copper through electro-metallurgical means into three (3) distinct classes. What applies to copper can also to a greater or less extent be applied to other metals, viz.: nickel, cobalt zinc, etc.

The three subdivisions according to Dr. Schnabel are—

a. The production of copper from ores.

b. The production of copper from matte, etc., etc.

c. The production of copper from crude copper alloys, etc.

Process *a* coincides with the direct production of metals from solution.

Processes *b* and *c* coincide with refining process.

(See German edt., *Handbuch der Metalluittenkinde*, Dr. Carl Schnabel, Vol. 1, page 250.)

There is a great difference between refining crude metal and producing metal from solutions using insoluble anode material, *no matter what may be said to the contrary.*

3rd. Regarding the advantages of producing metals from a sulphate as against a chloride solution, this fact is certainly not decisive and should receive more consideration. I admit that the chloride process is old and has not yet attained prominence, but the sulphate method is older, and before its successful introduction had the same obstacles to contend with that are now blocking the chloride method.

In refining from a sulphate solution one kilo watt hour at a potential difference of 0.5 volts will produce 2.36 kilos of copper. From a chloride solution working at the same potential difference (0.5 volts) 4.72 kilos of copper are produced by one K. W. H. I admit that it is difficult to hold the potential difference of a chloride bath down to 0.5 volts but the same has been successfully accomplished.

The above figures may speak for themselves regarding THE SPEED OF REACTION.

The assertion of Mr. Ulke to the effect "that it is out of the question at the present time for large refiners to go to the expense of erecting a costly plant for liquifying chlorine, producing bleach, etc., WHEN IT IS CONSIDERED that the returns would be reduced to an unprofitable low figure *as soon as such methods were* GENERALLY ADOPTED," speaks for itself. (Special emphasis upon general adoption.)

7th. Concerning the obtaining of pure nickel through the electrolysis of a slightly heated ammoniacal nickel sulphate solution using lead anodes, I have only to repeat what has been said in my communication of the 4th inst.

For the benefit of those who may read these comments I wish to state without going into details regarding method that in the quantitative determination of nickel, the compound containing same is brought into the condition of a sulphate solution, the nickel is separated from other metals associated therewith, the solution made ammoniacal and this ammoniacal nickel sulphate solution subjected to electrolysis using platinum anodes and cathodes. To hasten this deposition and also to obtain a firmer plating the solution is kept slightly heated during the time that the electrolytic deposition takes place. Therefore with all due regard for patents, I will leave the decision as to whether I MADE AN ERROR OR NOT to the judgment of those who may read these comments.

Very truly yours,

WM. KOEHLER.

Cleveland, June 27th, 1902.

Power Drills.

By MR. C. C. HANSEN, Montreal.

In opening this discussion about power drills I will, with your permission, give a short description of a few of the better known types.

We find in all cases that the power drill consists of the following parts: The cylinder, piston, rotating mechanism, and valve. These constitute the working parts of the drill, and are mounted in a frame or shell, provided with means for feeding it ahead as the drilling progresses.

For work on the surface, the drill is usually supported on a tripod, which is placed over the spot where the hole is to be drilled, and when the desired depth is reached the whole apparatus is moved to the next place, usually a few feet distant. For underground work, such as shaft sinking or drifting, a column or bar is used, as several holes can be drilled from the same position of the bar, and a tripod is difficult to handle under ground where the room is confined. The drill is fastened to the mounting or support in such a way that nearly all the space can be reached and the holes drilled in any desired direction.

In the end of the piston that extends outside the cylinder, provision is made for fastening a drill steel or bit, which must be changed for an average size drill say every two feet in depth, which is the extent of the feed, or oftener, according to the time it takes to wear of the cutting edges on the drill steel.

The work of a power drill consists in the piston travelling forward and backward in the cylinder, actuated by the pressure from steam or air, according to what is available. The number of double strokes or blows will vary between 250 to 500 per minute. The forward stroke against the rack is uncushioned, that is, the drill steel fastened in the piston must take the full force of the blow, but the force of the backward stroke is taken up in a cushion by admitting the pressure into the back end of the cylinder before the backward stroke is completed. The work of the piston is controlled by the valve mechanism, which alternately admits the pressure at the top and exhausts it at the bottom.

In this valve mechanism, or the means for controlling the forward and backward strokes of the piston, we find the greatest difference in the various types of power drills, which I will show you later.

An important feature of the power drills is the rotating of the piston during the work. If the position of the drill steel remained the same during a number of blows, the consequence would be that the steel would wedge fast in a very short time, the hole would not be round, but the shape of the bit, and power wasted. It is therefore necessary to rotate the bit a small part of the circle between each blow. This is accomplished by boring out the back end of the piston to give room for a "rifle bar," which is part of the rotating mechanism. The usual thing is to place a ratchet ring in the back end of the cylinder, supported between washers, the one on the inside having a hole in the

centre for the rifle bar to pass through. In the inside circumference of this ratchet ring are a number of teeth or ratchets. The head of the rifle bar contains two or more pawls that will engage the teeth or ratchet in the ring, when the rifle bar is turned in one direction, but pass over the ratchets when turned in the opposite direction. Each rifle on the bar is a screw-thread that will make a revolution in about 60″ and the bar contains, usually, five or more rifles. In the end of the piston is placed a nut that fits the rifles in the bar. This mechanism is so arranged that on the forward stroke the pawls will pass over the ratchets, and allow the rifle bar to turn, but on the backward stroke the pawls will hold the rifle bar fast and the piston will turn a small part of a circle. As the stroke of an average size drill is about 6½″, the piston will describe a revolution in about nine strokes, so that the force of the blow is fairly well distributed over the bottom of the hole.

Fig. 1.—This sketch shows one type of power drill in which the valve is operated by the reduced part of the piston proper, alternately covering and uncovering two parts connected with the respective end of the valve chest. The position of the valve is for admitting pressure to the back end of the piston for the forward stroke. The space between the cylinder and the reduced part of the piston is always in connection with the atmosphere through ports leading to the exhaust. As the piston travels forward until this port is covered, all the pressure on this side of the valve will be exhausted and the small amount of pressure that will pass by the solid part of the valve is sufficient to hold it in place, as the piston travels farther on the forward stroke the port connected with the back end of the valve will be opened to the atmosphere and the pressure on this side exhausted, which will shift the valve to the opposite position from that shown.

Here you see the cylinder which contains the ports to each end of the valve chest, the piston, consisting of the piston proper, the piston rod or shank and the chuck for clamping the drill steel. The rotating mechanism and the valve and chest.

Fig. 2.—This sketch shows another type also operated by a floating valve which is again actuated by small ports covered and uncovered by the reduced part of the piston. This sketch shows the cylinder, valve mechanism and part of piston only.

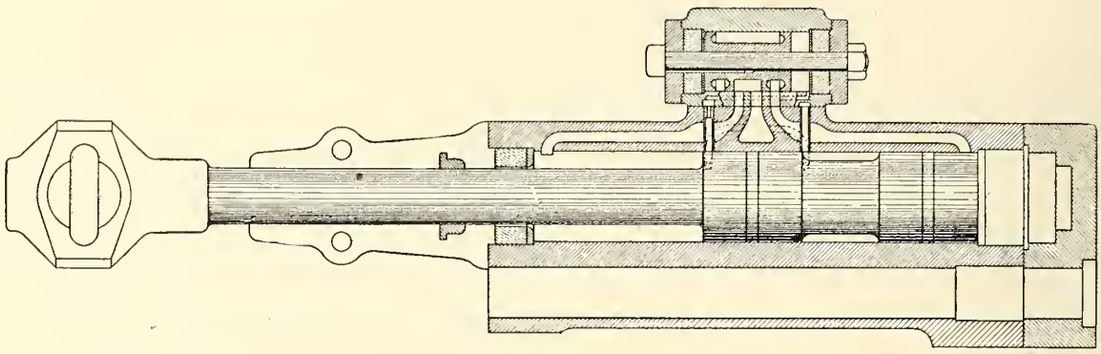


Fig. 1.

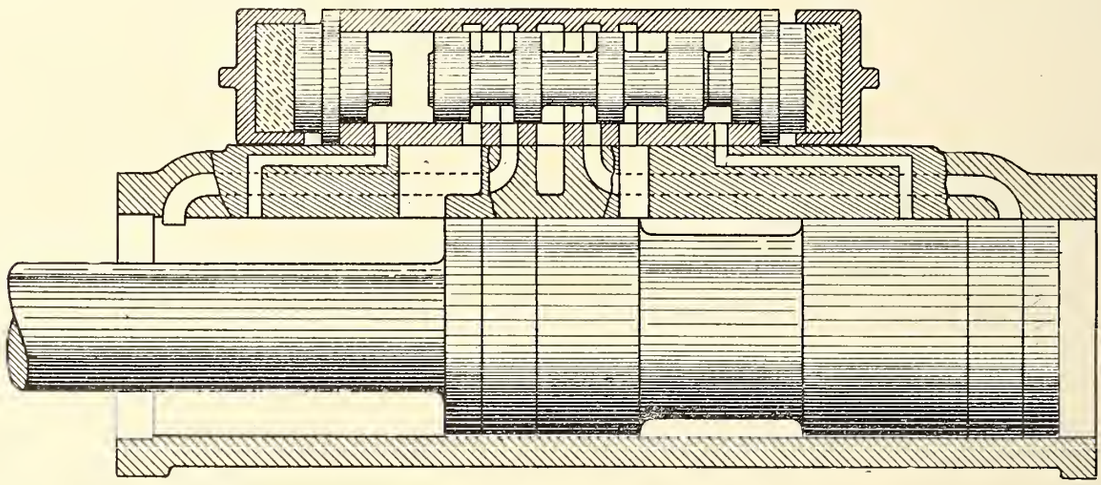


Fig. 2.

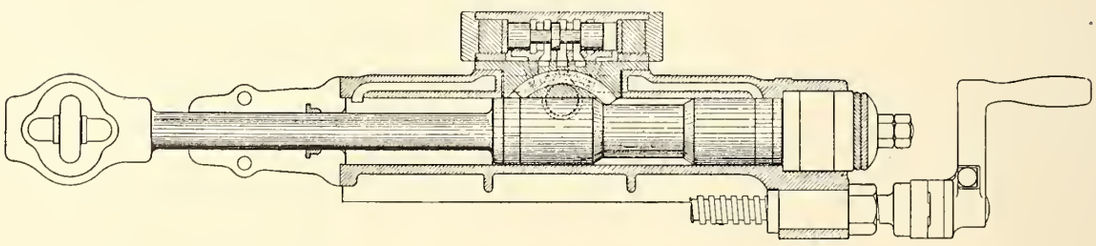


Fig. 3.

Fig. 3.—This sketch shows some departure from the previous described types in regard to the valve. We find still the floating valve controlling the piston, but this valve is actuated by an auxiliary valve, which is again operated by the piston. This auxiliary valve is really nothing else but a slide valve, which alternately admits and exhausts the pressure at the respective ends of the floating valve with which it is connected by means of small ports. The auxiliary valve is made in the shape of an arc of a circle, and is moved by the reduced part of the

piston. The space between the reduced part of the piston and the cylinder walls is filled with pressure and not, as in the previous cases, open to the exhaust.

Fig. 4.—Here the result has been accomplished in a different way. The valve is a plain D slide valve, which is operated by a tappet or rocker supported on a pin that passes through the cylinder wall. The high parts of the piston will strike one or the other of the two arms and allow the other to go down in the reduced space of the piston, and the third arm will move the valve.

Fig. 5.—Here we find another "tappet" only much the same as the one previously described. The valve, you will notice, is part of an arc on the face, with the pin supporting the tappet for centre.

The amount of work done by a power drill is usualiy measured in lineal feet of hole drilled in a given time. This again depends on the kind of rock, the depth to which the holes are drilled, troubles that may be caused from seamy rock, when it is difficult to keep the hole straight, and last, but not least, the drill runner. Comparison is, therefore, difficult if not impossible. I know cases where twenty lineal feet drilled in eight hours would be considered good work, and other cases where from three to four times this amount would only be considered fair.

In some of the Western mining camps drilling matches are held, usually on the Fourth of July and Labor Day, the manager putting up a prize for the winner. It is useful in more ways than one, because it gives an idea of what a man can do, and has a tendency to keep up a spirit of competition between the men, for it is considered quite an honor to be the best drill runner in the camp. The drill runner is no doubt a very important factor in the amount of work that can be done with a power drill, for experience counts here as well as in most other things, but, as stated, the condition of the rock and work has a large influence. From my experience I should say that from twenty to eighty lineal feet may be drilled in a day. Sometimes this is exceeded, as proved by an instance where one man and a helper drilled 218 feet in a little over nine hours. This was done with a 3½ inch drill mounted on tripod and in an open cut.

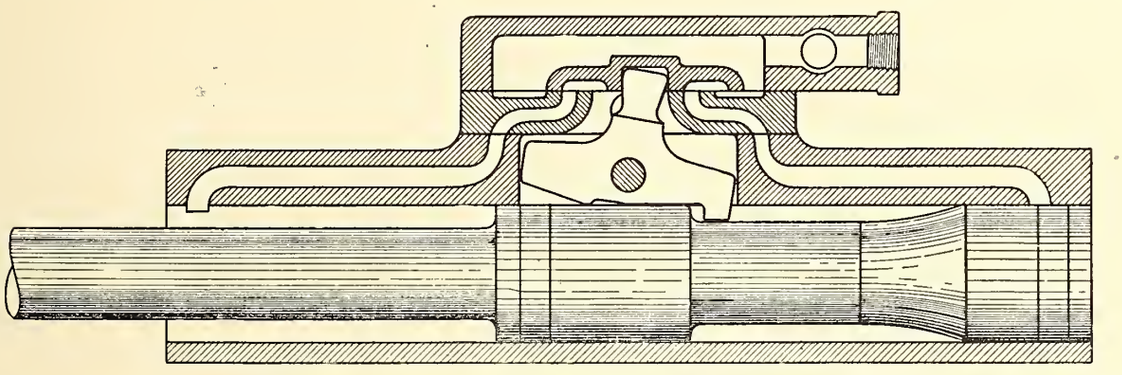


Fig. 4.

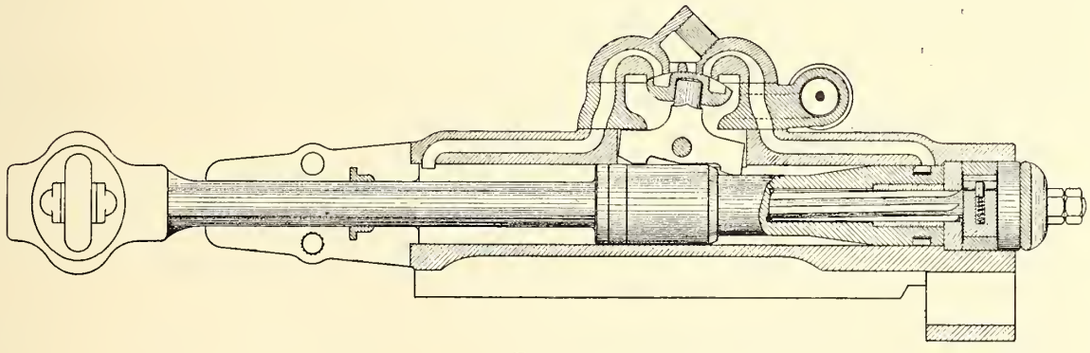


Fig. 5.

The Ore Deposits of Copper Mountain, Similkameen District, B.C.

By O. N. Scott, School of Mining, Kingston, Ont.

LOCATION.

Copper Mountain is about 13 miles south of Princeton on the east side of the Similkameen River, in the Similkameen sub-mining district, which embraces the great south-eastern portion of the Yale District, B C., and is drained by the Similkameen River and its tributaries.

This district contains many large deposits of low grade copper ores, some of which have been prospected considerably, but lack of transportation facilities has hindered that development which would be necessary to determine more exactly the value and extent of these deposits.

However, on Copper Mountain are to be found large surface outcrops of copper ore, and on the deposits development work has been carried on, to a limited extent, but yet more than in any other part of the district.

It is to the description and characteristics of the ore deposits of Copper Mountain (on the Sunset and H.H. Gardner mines) that I wish to draw the attention of the members of the Institute, from observations made by myself in July of last summer.

GEOLOGY OF COPPER MOUNTAIN.

Copper Mountain rises abruptly from the Similkameen valley to a height of about 2000′ or 2300′ above the valley, and covers several square miles.

It consists chiefly of masses of volcanic rocks, which probably are pre-tertiary, although in altitude they are found above the tertiary coal seams in the valley bottom.

The explanation of this is that these tertiary rocks occupy an original depression in which they have been protected from denundation by the surrounding more resistant rocks. They probably form part of a series which once covered the whole surface of the country, but

which, owing to denundation, now appear merely as isolated remnants, resting on the older rocks.

These are comparable to the tertiary of the Kamloops district, described by Dr. Dawson,* and the tertiary outlines of the Kettle River, mentioned by Mr. R. W. Brock in the summary report of the Geological Survey in 1900.

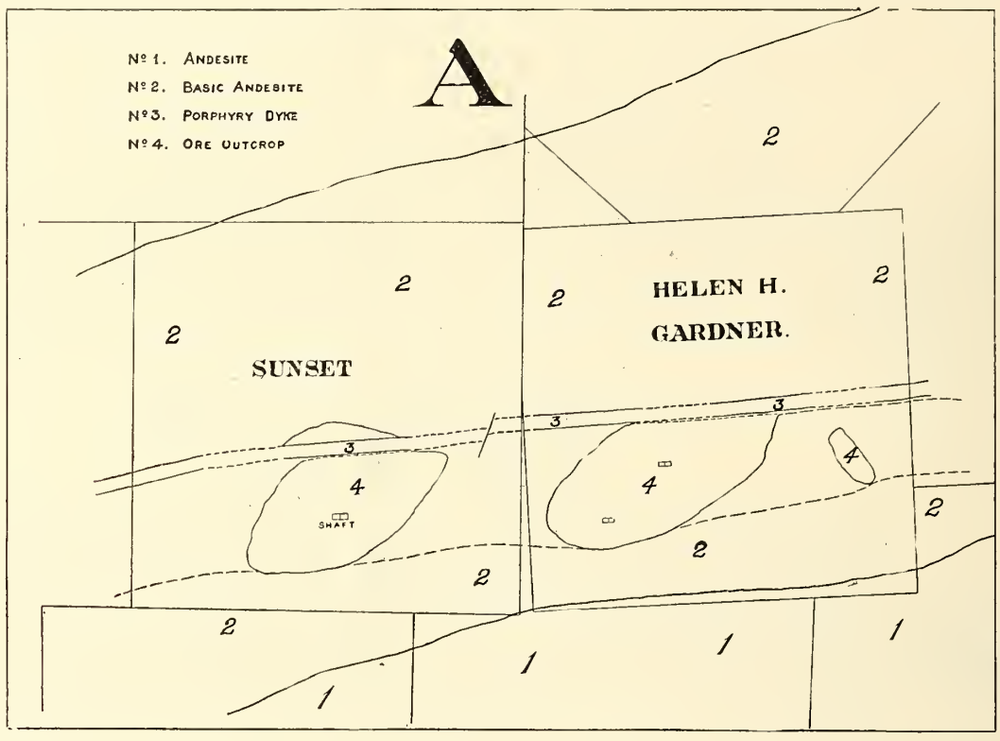
On the accompanying diagram "A" I have sketched part of the volcanic areas which are associated with the ore bodies of the "Sunset," "Helen H. Gardner," "Sunrise," and other properties lying on the summit and western slope of the mountain; a cross section of same is shown in "B."

The part colored in brown, No. 1, represents the area of fine-grained greyish-looking rock of the following composition:—

A—

SiO_2	52.33
Al_2O_3	18.80
Fe_2O_3	10.21
MnO_2	none
CaO	8.22
MgO	4.189
K_2O	3.62
Na_2O	3.842
Total	101.211

A thin section under the microscope shows its chief constituents



The green colored band (No. 2) is an area of basic volcanic rock, greenish in color, and of fine texture.

Its analysis is given in "B."

	B	C	D
Locality	Copper Mt.	Japan.	Nevada.
SiO_2	50.48	50.87	50.38
Al_2O_3	13.92	21.98	19.83
Fe_2O_3	15.04	10.94	8.05
MnO_2	.0088	1.45	.....
CaO	11.28	9.12	10.33
MgO	4.083	1.38	5.36
K_2O	.0355	.02	1.76
Na_2O	3.611	2.85	2.15
S	1.1083	.....	.....
	99.5666		
Sp. Gr.	2.8571		

Under the microscrope a thin section showed it to be considerably altered and decomposed, but consisting of plagioclase feldspar, augite, and biotite.

It also shows a microscopic brecciated structure. According to its analysis, chemical and microscopic, I have classed it as a "basic andesite," although on account of its age, following the German petrographers, we might speak of it as a "porphyrite."

In comparison with an audite andesite (C) from Japan mentioned by Rosenbusch, it shows a striking similarity in chemical composition when we group the ferro-magnesian constituents and silica content.

This basic andesite shows in chemical analysis milarity to the basalt of Richmond Mt., Eureka district, Nevada, given under "D," described in Kemp's "Handbook of Rocks."

* Geological Survey Report, 1894, part B.

to be plagioclase feldspar, also smaller quantities of orthoclase feldspar with crystals of augite and biotite. The constituents are well crystallized and do not show alteration or decomposition. I have classed this as an "augite andesite" according to the above microscopic and chemical analysis. This andesite is evidently a later intrusion in the "Basic Andesite," since a well-defined "Salband" occurs along the contact.

The pink colored parts, No. 3, represent a series of quartz porphyry and porphyry dykes that strike in an easterly and westerly direction, c utting through the basic andesite and dipping into the mountain.

The analysis of two samples ran:—

	E	F
SiO_2	72.5	71.65
Al_2O_3	11.51	14.10
Fe_2O_3	5.25	4.42
CaO	.44	.51
MgO	traces	traces
K_2O	5.252	4.542
Na_2O	6.012	6.644
MnO_2	.....	traces
	101.03	101.866
Sp. Gr.	2.571	2.510

Under the microscope, a thin section of this porphyry shows quartz of distinct crystal outline, in a ground-mass of orthoclase feldspar.

The quartz porphyry is of fine texture, and is a hard brittle rock.

"F" is an analysis of a porphyry outcrop in the "Helen H. Gardner," not showing similar characteristics in hand specimens—that is, absence of quartz crystals—but the chemical analysis is close to "E."

It is therefore probable that it belongs to the same dyke or series of faulted dykes as that which occurs on the Sunset property.

THE ORE BODY.

The ore body on the "Sunset" and "Helen H. Gardner," which are adjoining claims, is roughly defined on the north by this quartz porphyry dyke, which has a width of about 75 feet, and forms the hanging wall. Contiguous to the dyke is the copper ore, not occurring in a well-defined vein, but in the form of bornite and chalcopyrite, impregnated and disseminated through the basic andesite, forming a large deposit that can be traced in an easterly and westerly direction for over 3000′, and varying in width from 50′ up to 250′.

This mineralization of the basic andesite with copper pyrites extends from the dyke outwards, becoming less and less mineralized till the ore gradually gives way to country rock.

This country rock (the altered basic andesite), forms a contact with the coarser grained andesite on the south.

ORIGIN OF DEPOSIT.

On a careful examination of the many hand specimens which were selected from different parts of the ore belt, one is impressed with the fact that the characteristic feature of the copper is its occurrence in small veinlets and seams through the gangue (basic andesite).

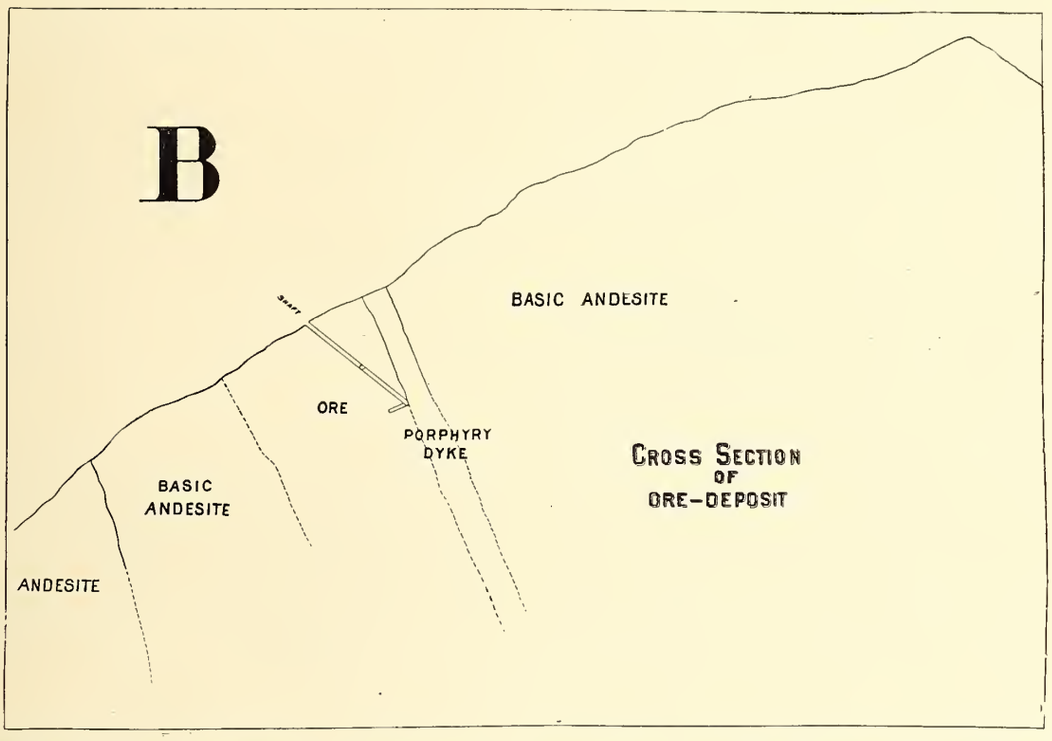
Under the hammer specimens would invariably break along these vein fractures.

That occurrence suggested to my mind that the ore deposit was of aqueous origin.

These fissures and cross-fissures would serve as channels for ascending copper-bearing solutions, which, it would seem, deposited their metallic contents in these veins.

Under the action of circulating water, the veins have been widened and adjacent country rock replaced with copper sulphides, by metasomatic action.

It is reasonable to suppose that a basic rock would undego de-



The ore from this deposit is most interesting in its character. In appearance it resembles closely the barren basic andesite, with the exception that it is cupriferous.

The bornite and copper pyrites are at times disseminated through the gangue (basic andesite) in small veins or veinlets, which look like a highly shattered mass cemented together with copper pyrites. These veinlets are quite irregular in their course, in fact, crossing and recrossing each other in intricate confusion, forming enrichments at contacts and again widening out into seams ranging from a fraction of an inch up to 6″ or 7″ in width, of solid bornite and copper pyrites

Associated with the sulphides of copper is calcite, as a gangue in filaments along the facets or again forming considerable seams. Very often the calcite and sulphides are intimately mixed.

By analysis I found an average sample of the ore to contain :—

G—

Cu	4.66
Au	20c. to $1.50 per ton
Ag	traces
SiO_2	42.25
Al_2O_3	9.26
Fe_2O_3	9.37
$CaCO_3$	34.74
S	1.65
	101.93
Sp. Gr.	3.0

composition under the influence of ascending mineral waters under pressure and probably containing CO_2, which would accelerate its solvent power.

In comparing the chemical analysis of the ore (G) to the basic andesite (B) it will be observed that the ore shows much lower percentages of ferro-magnesian and SiO_2 constituents and total absence of alkalies than the basic andesite, indicating that the augite and feldspars have yielded to a solvent.

Also under the microscope a thin section of the mineralized country rock showed the feldspar kaolinized and in places surrounding crystals of pyrites. Also, the ferro-magnesian mineral augite had undergone decomposition and was replaced in part by crystals of pyrite ; thus the microscopic and chemical analyses prove directly the replacement of the feldspar by the pyrite.

Again, the fact that calcite occurs as a gangue in these fissures in connection with the copper sulphides would indicate deposition from solution.

If we seek for an explanation of the genesis of the deposit in an igneous theory, it must be explained why the sulphides are not more or less evenly disseminated through a gangue or segregated in solid masses ; whereas quite the reverse is a case for Copper Mountain ores.

Here the bornite and chalcopyrite are deposited chiefly along fissure lines, leaving the country rock quite recognizable.

The origin of the mineral contents of the deposit was not local, that is, the material was not brought in and deposited by "lateral secretions," because the analyses show there is no concentration of the iron from the surrounding rocks, and that these rocks have not been leached, so that the material must have come from depth.

Referring to the accompanying sketch, you will notice that I have indicated the quartz porphyry dykes in pink color.

These dykes follow the general course of the ore bodies, that is, east and west, and usually form the hanging wall, although one case was found where ore occurred on both sides of the dyke.

In these rugged mountainous regions, where the process of tilting and folding has been active, eruptive dykes have caused further rupturing and fissuring of the country rock, which probably may have been accelerated later by earthquakes, etc , etc., so that I attribute the formation of the intricate fissuring which extends from the dykes outward into the country rock to the forcing of the quartz porphyry through the basic andesite. At least the later fine fissuring was due to this.

I shall further try to show that the porphyry dykes have a relation to the ore deposit, a relation which is chiefly mechanical and not chemical.

The chemical analysis of two specimens shows them to be highly siliceous rocks, so that they would be highly insoluble compared to the contiguous basic andesite.

A thin section under the microscope showed that its constituents were not altered or decomposed, indicating also its impermeability to circulating solutions. Therefore, these fine-grained acidic eruptives were impervious to ascending solutions, but acted as a barrier to horizontal circulation and directed the course of mineral-bearing solutions upward along the lines of dislocation and fissures.

In that way the permeable basic andesite was brought under the influence of ascending mineral solutions, which, by their dissolving power, would readily attack the feldspar and ferro-magnesian constituents of basic rocks, enlarging the already existing fissures in such lines of decision and depositing their metallic contents.

The augite andesite (No. 1) does not show mineralization on account of its compactness, lack of fissures, and absence of porphyry dykes.

In the Similkameen district quartz porphyry dykes should cause the prospector to thoroughly examine the contiguous rock for ore deposits or indications of such.

In the Boundary country, 150 miles east, I have noticed somewhat similar acidic dyke rock in the B.C. mine (Summit Camp) in contact with the rich Cu. sulphide ores, also at the "Rathmullen" and "Blue Bird" mines in the same camp, so that the relationship of the dyke to the ore bodies in the Similkameen may be applicable to the low grade deposits of the Boundary country, which may also owe their genesis to ascending mineral solutions.

If the genesis of the ore is attributed to ascending solutions, their source must have been deep-seated, hence a favourable indication of the continuance of the ore in depth.

SURFACE INDICATIONS.

Copper Mountain ore deposits are generally covered or partly covered with "detritus" or wash, and since the copper ore does not contain a high percentage of iron, heavy gossans (or insol. iron oxides) do not occur to indicate bodies of sulphides below.

Ar the surface of the "Sunset," "Helen H. Gardner," "Sunrise," and other Copper Mountain ore deposits, the soluble copper content has been leached out by surface waters, aided by the oxidizing action of the atmosphere changing the upper part of the deposit to a barren or lean copper ore, and in the lower regions forming enrichments.

In the upper parts of the deposits carbonates of copper form blue and green stains in the rock, the well-known surface indications of copper ores, although when no wash covers the outcrop very little carbonate stain may be left owing to its contact with the rains and atmospheric agencies.

MINING AND TREATMENT.

The Copper Mountain ores are of a type common to the whole district. The large deposits of low grade copper ore, averaging from two and a half to seven per cent. Cu, and small amounts of Au and Ag, which vary in width from 40′ to 250′ and, showing good indications of permanency in depth, are comparable to the Boundary district ores.

In the Boundary some of the large deposits are quarried, giving a large production at a low cost per ton. Copper Mountain deposits, lying on a sloping mountain side, would afford favourable conditions to cheap mining by a system of quarrying.

The Boundary ores are self fluxing and smelted at a low cost. Copper Mountain ores should offer no great difficulty in being smelted at as low, or nearly as low a figure as these. The aluminium contact is somewhat high, but not high enough to cause serious trouble in the furnace.

Within the last month, reports have come from Princeton of the discovery of a 10′ bed of bituminous coal, which is said to be of a good coking quality. It is less than ten miles from Copper Mountain ores, and should furnish a cheap fuel for the smelting of ores of the whole district.

Therefore, under competent management, and a careful development of the deposits, together with a local supply of fuel, these ore bodies bid to become valuable copper producers in the near future.

Le Roi.—Cable:—"There were shipped from the mine to the smelter during May 13,000 tons of ore, containing 7,172 ozs. gold, 10,980 ozs. silver, and 450,870 lbs copper. Estimated profit on this ore $60,000. Great Northern Railway have made rate second-class ore 25 cents, promise coke early next month, delivered at Northport $6.80 per ton." (Office note.—The reductions of the freight rate on second-class ore to 25 cents and of the price of coke from $9.50 to $6.80 are the outcome of lengthy negotiations, and will materially reduce the operating expenses.) (April shipments:—26,093 tons, containing 8,689 ozs. gold, 18,079 ozs. silver, and 706,224 lbs. copper.)

Enterprise (British Columbia).—Cablegram from Nelson, B.C.: "Estimates of last month's receipts, $7,190; expenses, $8,060; does not include 100 tons zinc concentrates, 70 ozs. of silver per ton of 2,000 lbs.; owing to a break-down at crusher, returns diminished."

Le Roi No. II.—Manager cables:—"Shipments last month amounted to 6,466 tons. Contents:—3,573 ozs. gold, 7,000 ozs. silver, 135 tons copper. The returns from ore, after making a reduction of all smelting charges, amount to $60,000. Cost of mining may be taken at $21,000. Profit for last month, $39,000. (Equivalent sterling, £8,041.)" (April shipments:—6,375 tons. Estimated profit, £9,278.)

Nimrod Syndicate, Limited.—Mr. R. D. Fetherstonhaugh, the manager of the Atlin Mining Company, Ltd., a subsidiary of the above syndicate, cabled on the 29th May as follows:—"We have cleaned up after a run of 50 hours, recovered 130 ozs., being the proceeds of 48 ft. of sluices."

Giant.—The Hon. C. H. Mackintosh, resident director at Rossland, cables under date 4th June:—"I have made contract with smelter (Canadian Pacific Railway Company's smelter at Trail), to smelt Giant ore at 18s. (per ton), a reduction of 25 per cent. Have opened up a fine body of ore. Assay value of gold per ton is $30." (Office note.—Hitherto the rate for smelting Rossland ores has been $6 per ton, and it will, therefore, be seen that our resident director has succeeded in obtaining a reduction of 25 per cent.)

Slough Creek.—The following cablegram, dated Barkerville, B.C., the 29th ult., has been received from the company's mine manager:—"Gravel was struck at 9 o'clock this morning in vertical borehole 6 ft. above crosscut; considerable water; gravel appears firm; is in good order throughout; every precaution has been taken to ensure getting through safely." Further cablegram, dated 2nd inst., says:—"Put up secondary borehole 3 ft. 6 in. forward—5 ft to the gravel—1 ft. in the gravel—water not increasing—wash is undoubtedly auriferous—prospects are most encouraging throughout the mine."

Cariboo Goldfields.—Cablegram from the company's engineer at Barkerville, Williams Creek, British Columbia: "The flume is being lowered so as to enable us to hydraulic gravel immediately above bedrock. Large returns cannot be expected until we get into lower level. I anticipate a marked improvement within the next fortnight. Gold contents of gravel are increasing. Expect to reach bedrock in about three weeks Water supply is plentiful. We have raised more gravel this year than during the previous three years put together. Promises to be a brilliant success as soon as opened up. Have sent to bank further small parcel of gold, 99 oz."

Mine Timbering in the Old Ironsides and Knob Hill Mines.

By H. P. De Pencier, McGill University, Montreal.

The Old Ironsides and Knob Hill mines are situated at Phœnix, in the Boundary Creek District in British Columbia, at the summit of the watershed of the Kettle River. The accompanying photograph shows the Old Ironsides head works on the left.

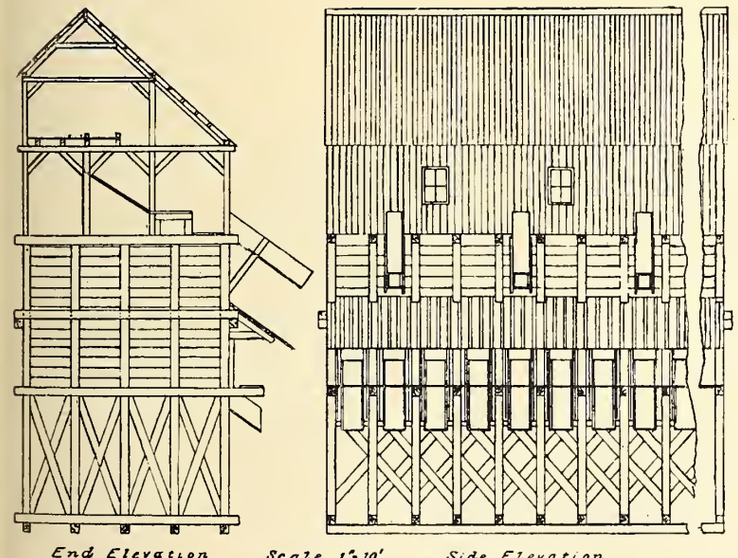
The ore bodies in these mines are very large, as will be seen from the accompanying blue print, which was kindly furnished me by the Superintendent, Mr. W. Y. Williams. This fact necessitates an extensive and thorough system of timbering the lower levels of these mines. The boundaries of these ore bodies have not yet been well ascertained, the ore appears to extend over 2,000 feet in length, while the width is not determined, though crosscuts from the footwall have been run for upwards of 300 feet.

The Old Ironsides has been prospected and developed by a system of shafts and drifts, showing the ore to extend down 400 feet, though work is not being carried on below the 300-ft. level. Stoping ground on the 200-ft. and 300-ft. levels has been opened up exposing blocks of ore running as high as 280 feet in width by 200 feet long; also, in an intermediate level, the 250-ft., ground 160 feet by 40 feet has been blocked out and is being stoped.

The Knob Hill is worked through a long adit tunnel, along which three blocks of ore 200 feet square are blocked out on at least three sides. On the surface, 150 feet above the level of this tunnel, an open cut or quarry is operated, and delivers ore to the tram system in the tunnel by means of shafts or shutes in the solid rock.

The foregoing brief description of these mines is merely intended to convey some idea of the immense size of the ore bodies, and hence the need for timbering when the ore is removed.

The ore in this wide mineralized zone does not form a very strong rock, though where (as in the Knob Hill) there is not much water and it has not been shattered, it forms a fairly safe roof for drifts and crosscuts.



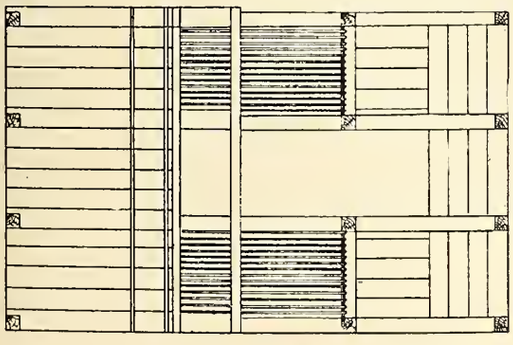


Fig. 1

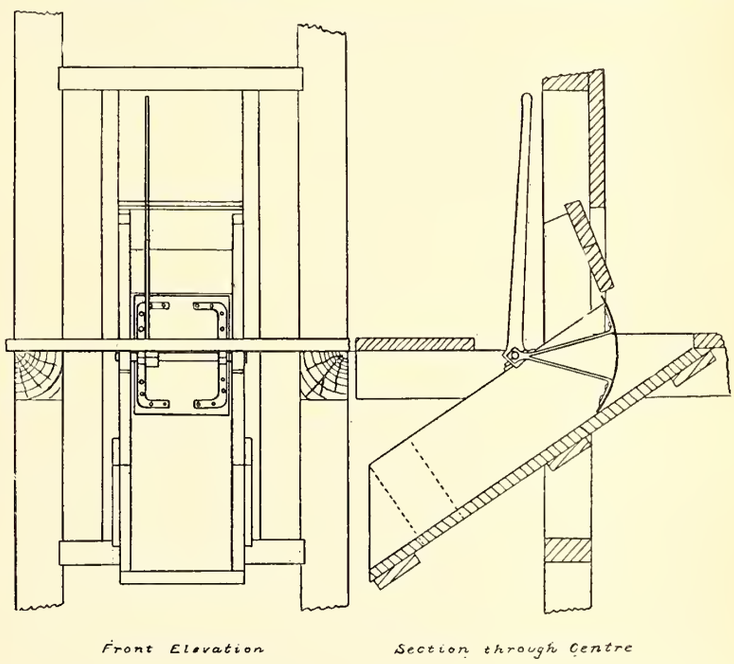
A large part of the timber used at both mines has been obtained on the claims, the country here being rather heavily wooded. The principal kinds of woods are pine, spruce, tamarac and Douglas fir; the three latter are regarded as of nearly equal value, the fir being the strongest and all three being stronger than pine, which, however, has the advantage of being softer and crushing more easily, so as to take up the load more evenly; for this reason pine is much used for making wedges.

Most of the timber on the claims has now been used and the supply for the future is being brought in by railway from outside points.

Posts and caps are cut from round timber, which has the bark peeled off to lessen the decay caused by moisture retained on the surface and below the bark when it is left on; this round timber is 10 inches and upwards in diameter, the posts being generally 15 inches up to 24 inches in diameter, while caps are smaller, the thickness across the flats at the post being 9 inches. Lagging poles are 5 to 10 inches in diameter.

Sawn timber is used in the construction of ore bins, hoists, and in the lining of shafts and shutes.

On the surface at both mines considerable timber has been used to build retaining walls to hold second grade ore and for making ground about the shafts and buildings. Round timber with the bark on is used for this; it is built into a wall by means of cross-pieces, forming cribs; these pieces are notched to fit the notches cut in the logs of the wall, and are run back into the bank where the weight of material resting against them holds the whole crib firmly in place.



LOADING SHUTE FOR ORE BIN.
Scale 1"=2'

Fig 2.

Both mines are equipped with ore bins capable of holding from 5,000 to 10,000 tons and intended for the storage of ore and its easy delivery from the mine to the railway cars. The general arrangement of them is the same and is shown in Fig. 1. The foundation is made of 12-inch square timber made into bents and resting on mudsills of the same timber; these rest on the solid rock.

The bents run crosswise of the bin at a distance of 5 feet from centre to centre and are strongly braced, the direction of the braces being changed in successive bents, while the bents are tied together by braces crossing three bents.

The floor of the bin comes directly on top of the bents; it is flat and horizontal; the ore takes the angle necessary for its removal.

The floor and sides of the bin proper are made of 4-inch plank, spiked solidly to the 12-inch square timber frame arranged as shown in Sketch 1; also 1 inch iron tie rods are freely used in addition. Along the front side of the bin a railway track is built, and above this on the bin a platform extends from which the cars are loaded by means of a series of shutes placed 5 feet apart from centre to centre. The details of these shutes are shown in Fig. 2; the gate is made of heavy iron 26 inches wide, it is pivoted as shown on an axle and opened by a long iron lever; two movable planks above the iron gate permit the attendant to bar out large rocks if they should stick in the mouth of the shute.

Above the main bin compartment proper the grizzlies and breaking and sorting platforms are built—a plan of these is shown in the lower sketch in Fig. 1. The grizzlies are made of 25-lb. mine rails cut to the desired length and strung, bottom upwards, on iron rods at each end, pieces of pipe placed between them on the rods make the desired space between them, about 2¼ inches. There are two such grizzlies, each 5 feet wide, with an open space between them, in each 15 feet of the length of the bin. This open space is used for dumping ore directly

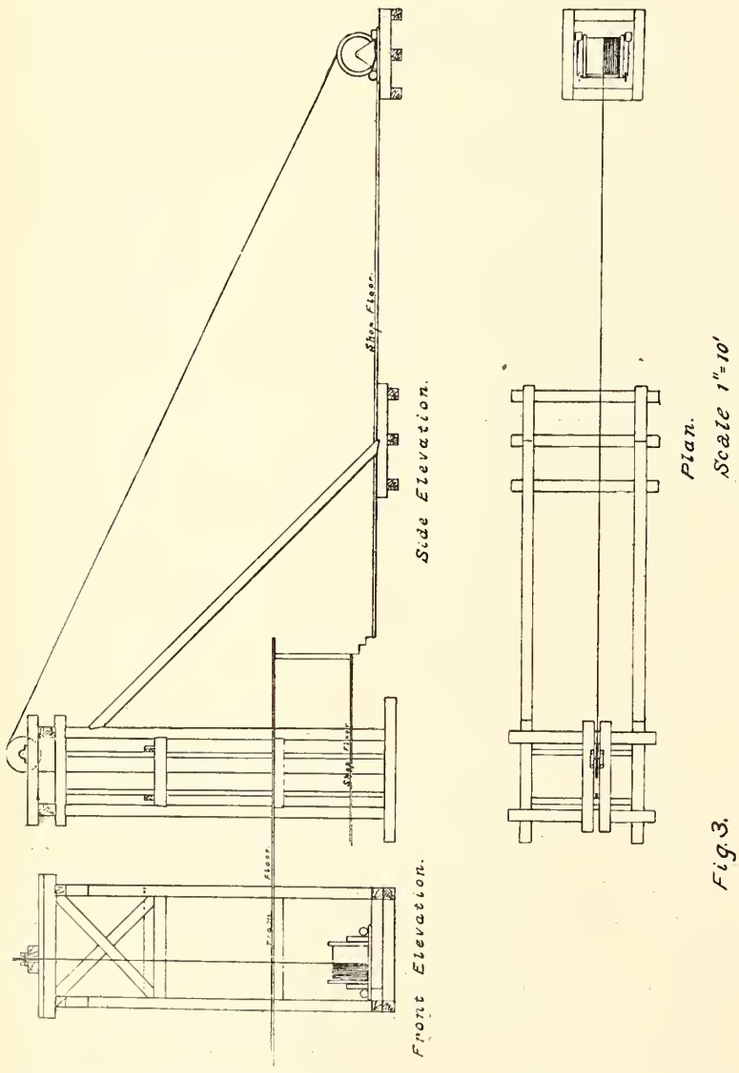


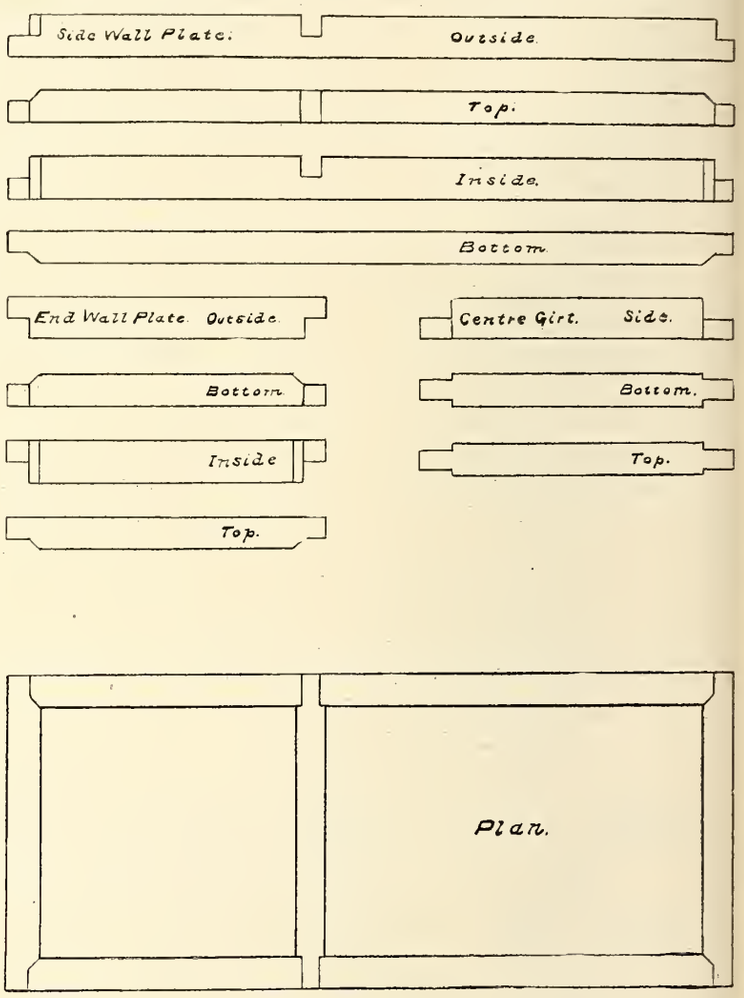
Fig. 3.

into bin when it does not require sorting or breaking; or by means of a shute a low-grade ore can be thrown out of bin at the back.

Above the grizzlies is the tram car level; the cars come from the shafts to the centre of the bins and turn either way on a steel turn-plate and are run to the desired compartment and dumped. A beam 4 inches square, running parallel to the track, about 2 feet from it, prevents the cars being overturned into the bin.

The whole structure is roofed with 1 inch boards to keep out rain and snow, which are abundant in this locality. The bin sketched is a small one with a capacity of about 18,000 cubic feet if full, or say 1,000 tons. There are in addition two others of much greater capacity.

The shafts in operation on the Old Ironsides are the original prospecting shafts and the "gallows frames" are not elaborate. Fig. 3 shows the plan and elevations of the one at No. 1 shaft. It is built of 12 inch square fir timber arranged as shown. Men and timber are taken on the cage at the shop floor level, while ore or waste is hoisted



Scale 2"=1'.

Fig. 4.

to the tram floor level to be taken to the ore bin or waste dump. As the hoisting engine is quite small, an elaborate hoisting frame is not required. The frame at No. 2 shaft is somewhat similar.

Both shafts have two compartments, one being for hoisting ore, &c., and the other for ladders, pipes, &c. Owing to the fact that they are lagged inside with 2-inch plank, I have not got full details of the timber in them.

Shaft No. 1 is cribbed for a part of the way down and Fig. 4 shows a method of framing timber for cribbing which is employed in British Columbia; it is a halved joint combined with a bevelled hitch on the inside to resist lateral pressure; it is improved if side and end plates are made to break joints so as to prevent one set slipping over the next.

The lower part of No. 1 shaft and all of No. 2 shaft is timbered with square shaft sets. Fig. 5 shows timbers cut for this purpose, with a halved joint and bevelled hitch, and the posts resting at top and bottom in a hitch to prevent them being forced inwards. The centre girt or divider is supported by a tenon and mortice joint; and centre posts are provided. The lagging in bad ground is placed outside of the timber and is supported on strips spiked to the plates; in safer ground the lagging is placed on the inside, being intended to prevent small rocks from falling in.



General View of the Knob Hill and Old Ironsides Mines, Boundary District, B.C.

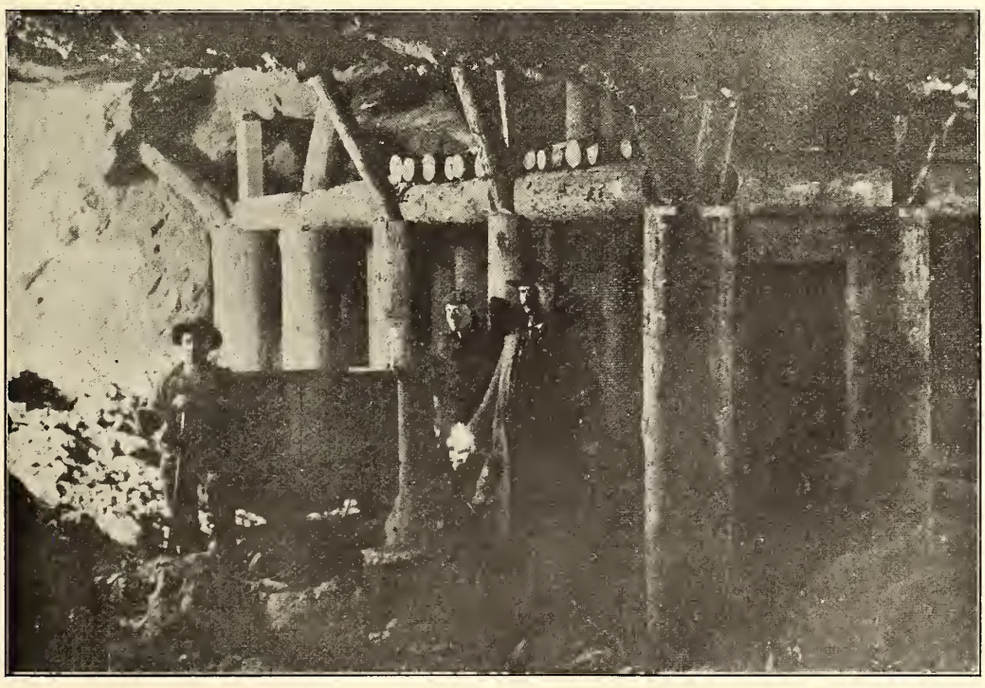


Photo showing arrangement of the Bottom Square Sets and Spragging at the Knob Hill and Old Ironsides Mines, B.C.

As the shafts are only prospecting ones the level stations are simple. Posts about 15 feet long are put in the shaft at the station and the upper end wall plates are run across the station a distance of about 20 ft., with suitable supporting posts and dividers or cap pieces; the lower end plates are also extended to form part of the sills for carrying the floor and steel turn-table plates.

Both mines are equipped with a track system. The rails are carried on wooden ties placed about 18 inches apart; these ties are flat on two sides and are 3 in. x 4 in., and 30 inches long.

The main haulage roads are lighted with incandescent lights; the wires are carried on small round timbers about 4 inches thick, wedged

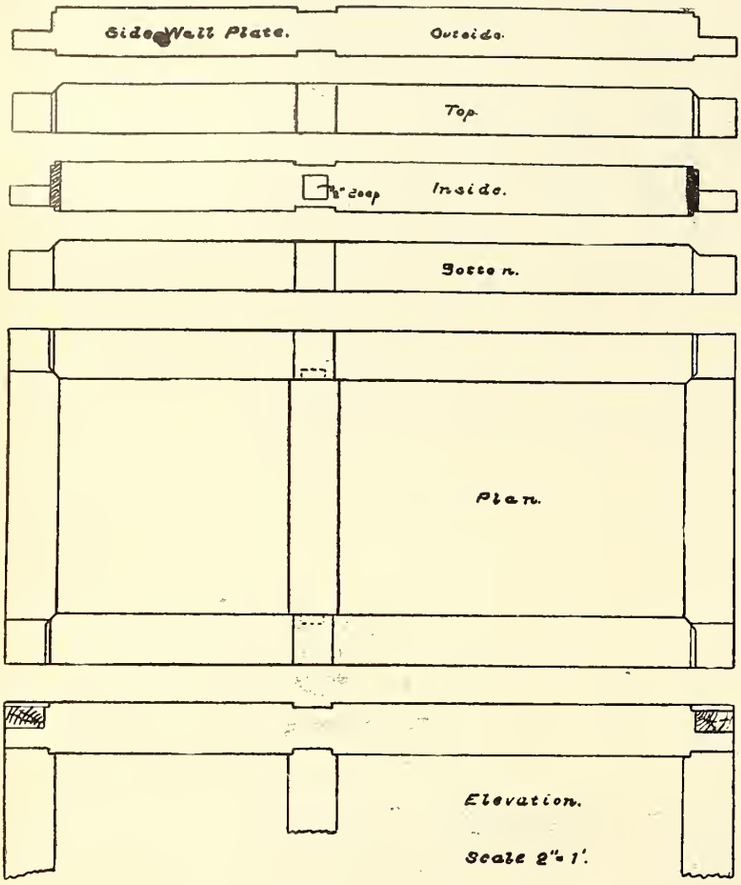


Fig. 5.

across the top of the drifts like a horizontal stull. Where there are tunnel or stope sets they are used to carry the wires.

The method of mining the ore in the Old Ironsides may be briefly said to be by overhand stoping. The stopes thus formed are filled with square sets of timber, and this timbering constitutes the most important item in the timbering of the mine.

The square sets are of round timber 8 feet in height placed 5 feet apart with cap pieces to hold them in their relative positions laterally. These posts and caps are securely wedged into place to carry any pressure resulting from settling or breaking loose of rock. Fig. 6 shows the shapes of the timbers; they are all round timbers except the bottom sills in each stope, which are 6 in. x 12 in. sawn timber. The sketches at the top of Fig. 7 shows the method of framing joints; in the drawing square timber is used for convenience in drawing. The lower drawing in Fig. 7 shows a number of sets put together; in it the posts are represented as being too small to allow of cutting the small shoulder for catching up the whole cap. This occurs sometimes with the round timber.

It will be noted that the framing of this timber is especially designed to carry vertical pressures,—the tenon on the end of the posts ensuring the position of the posts in the different floors of the stopes being directly above the corresponding post in the floor below.

It will also be noted that this system of timbering is very elastic and can be applied to ore deposits of almost any shape and size.

This timber is all framed on the surface by special carpenters. Fig. 8 shows the framing platform which is situated in a convenient place above the shafts and below a spur of the railway from which the timber can be unloaded and rolled direct onto the platform, framed, and rolled off onto piles near the shafts.

It is cut up into caps and posts to the best advantage. Fig. 6, *a*, *b*, *c*, show templates, straight edges and squares used by the framing carpenters. All timber should be marked off and measured from a centre line. It may be mentioned that this method is about to be abandoned at this mine and the timber framed by machinery.

The timber is transported to the shafts on a 30 inch gauge track and lowered into the mine by the "muckers" of the night shift; and stored in convenient places near the shaft stations. In this connection it may be noted that it is advisable to store it in as dry a place as possible, as the drier and lighter it is the more easily and expeditiously the heavy pieces can be handled.

From the stores underground the men of the day timber crew take it as required to the various parts of the mine on small timber trucks running on the ordinary mine tracks.

If the timber is being put in on the bottom of the stope, the first operation is to get the 6 x 12 inch sill accurately in place. This may

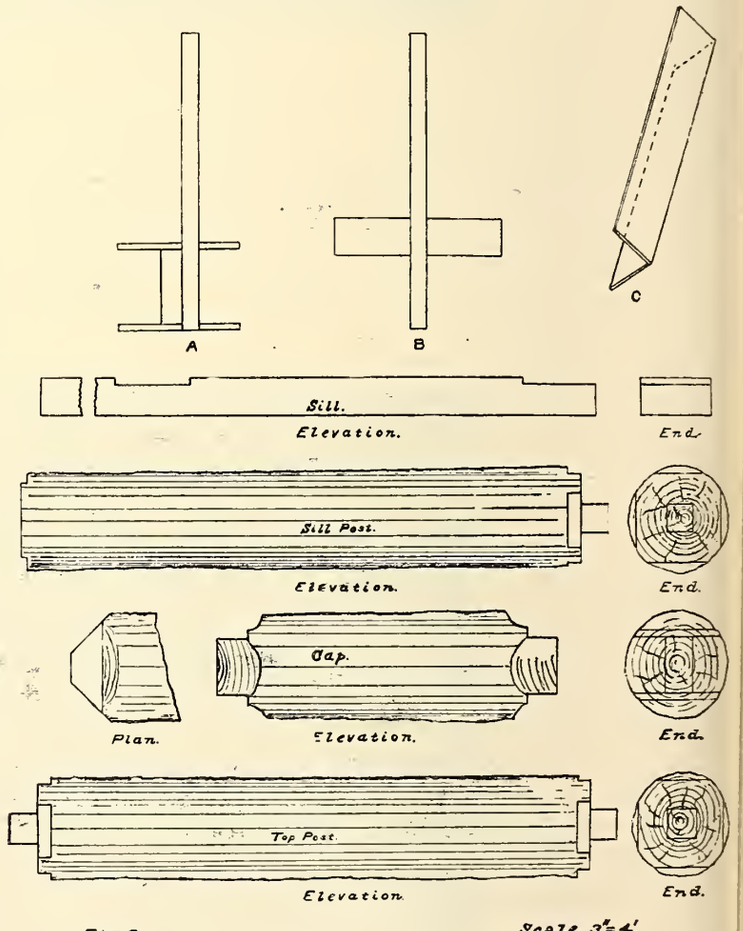


Fig. 6. Scale 3"=1'.

be done by the engineer giving level and location with his instrument, or it may be placed by reference to the adjacent timber, if there is any, by levelling and measuring across from the sills. When the sill is tamped accurately to its true position the sill posts are set in position in the open mortices in the sill, then the caps are put on and the whole is "spragged," or braced and wedged securely in place. It is usual to brace and wedge caps and posts from the adjacent walls, and the roof also in the case of the caps by a large vertical sprag set on top of the

caps meeting at a post. The accompanying photograph gives some idea of the arrangement of the bottom square sets and the spragging. The secure bracing of the timber requires both judgment and experience, and is a good test of the timberman's ability.

Next the lagging of round poles is laid on top of the caps; the lagging poles are from 4 to 10 inches in diameter, 10 feet long and have the bark left on. Not more than four square sets of lagging is

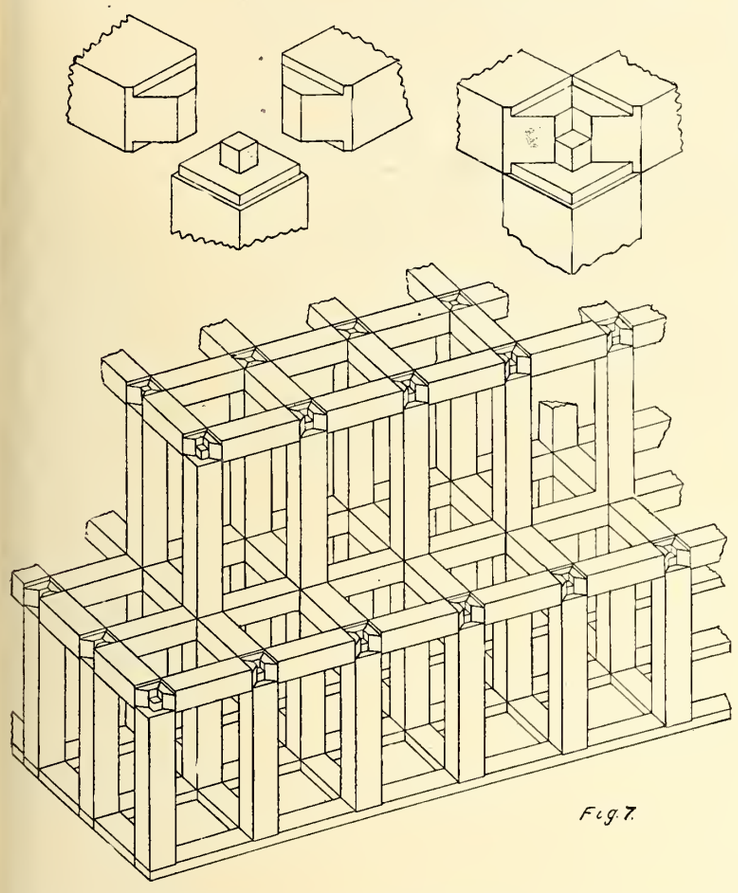


Fig. 7.

laid in the same direction, *i.e.*, a square 10 feet on the side; the adjacent lagging is laid at right angles to this to give a better support to the ends.

If the timber is to be used on floors above the track level it must be hoisted from the level; to do this shutes are built through the lower floors—they are made either of plank spiked to the lagging, or of lagging, the top being spiked to the cap and the bottom ends resting on the next lower floor behind the caps so as to be out of the way of the timber being hoisted.

The hoisting engine used is shown in Fig. 9, a photograph from the maker's catalogue; it is driven by compressed air from the mine mains. This engine is in common use in British Columbia for this purpose. It is made in two sizes with double cylinders 5 and 6 inches in diameter, and drums 12 x 21 inches and 14 x 24 inches respectively. The 5 inch engine is said to be capable of lifting 1,400 lbs. 100 feet per minute. The pistons are of the trunk type, there being no crosshead or slides; the crank discs are carried on the small shaft at the top; this shaft is geared to the larger shaft on which the drum is loose and is connected by a V friction between the drum and the large gear when running. This engine is mounted on nine car wheels for transportation underground and braced securely to walls and timber when used. Each engine should be equipped with air hose, wrench, and oil can.

One inch manilla rope is used on the drum, with a single pulley block fastened to the timber of the upper floor, the end of the rope is fitted with a pair of steel hooks for hoisting caps and posts; lagging is tied together and hoisted in lots.

Timber is moved about the upper floors by means of a pair of steel tongs like ice tongs.

As yet no reinforcing sets have been used. Heavy ground is held by putting in diagonal braces, or by extra spragging and cribbing with solid timber cribs built in between the rock and the regular sets to prevent a fall beginning.

In the centre of the large stopes cribs filled with waste rock or, in some cases, with ore are carried from the bottom level up with the timber; this is intended to steady the timbering in the stope. This filling pillar is usually 15 or 20 feet square and is retained by large lagging split and placed behind the posts.

Where a turntable is put in the track in the bottoms of stopes a post is left out at opposite corners to allow of long timbers being turned; an 8 x 8 inch upright is bedded on rock beside the adjacent posts and a 12 inch square timber on top of these supports the regular caps.

On the bottom of the stopes shutes for drawing the ore from the floor above to the mine cars are built in every 15 or 20 feet along the tracks; they are built of 6 inch plank, the mouth is 5 feet above the track and is 26 inches wide.

Very little timber is used in drifts and crosscuts, only a few square tunnel sets resting on sills and measuring 4 x 7½ feet are used.

In winzes and raises stulls are placed across in the usual way to support the platforms and ladders. Ladders are 10 feet long, sides 3 x 4 inches, rungs 4 x 1½ inches, 18 inches long, and 14 inches apart.

Fig. 10 shows the head frame used in sinking an inclined winze

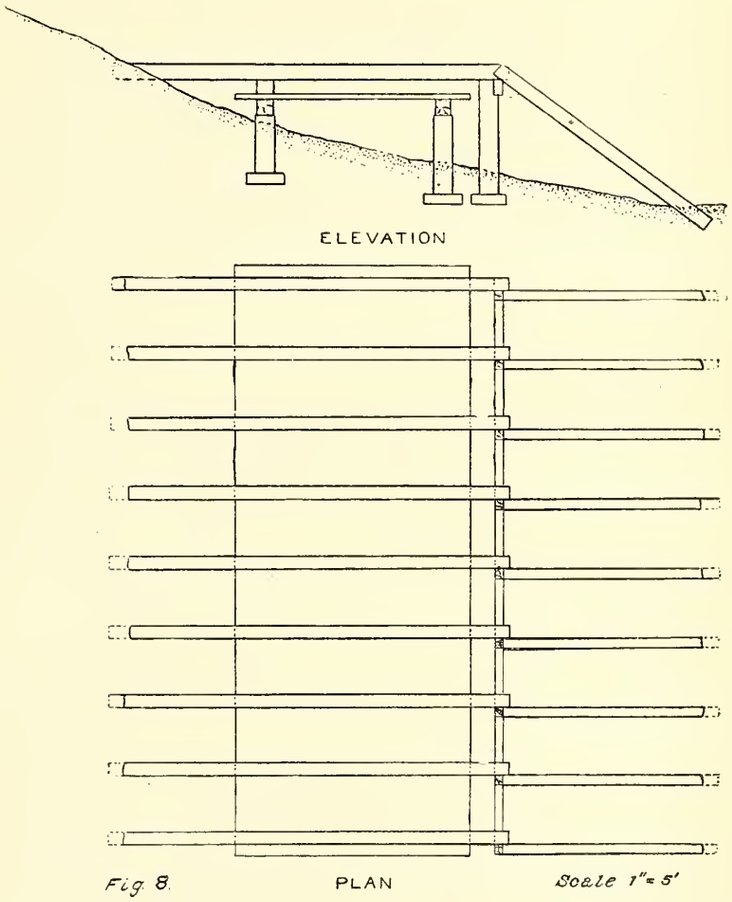


Fig. 8. Scale 1" = 5'

with a bucket, the posts are wedged solid to the rock so that no bracing is required.

Fig. 11 shows a very strong shute placed on the 300-ft. level to draw ore from the 250-ft. level stopes. Similar shutes are used in the Knob Hill at the bottom of the shafts from the surface quarry.

Fig. 12 shows a plan and elevation of an underground station in the Knob Hill from which a vertical shaft over 200 feet deep has been sunk. The frame is made made of 8 x 8 inch and round timber; the posts of the gallows frame are 12 inch square timber, no braces are required as the tops rest against the rock. The station is lagged with

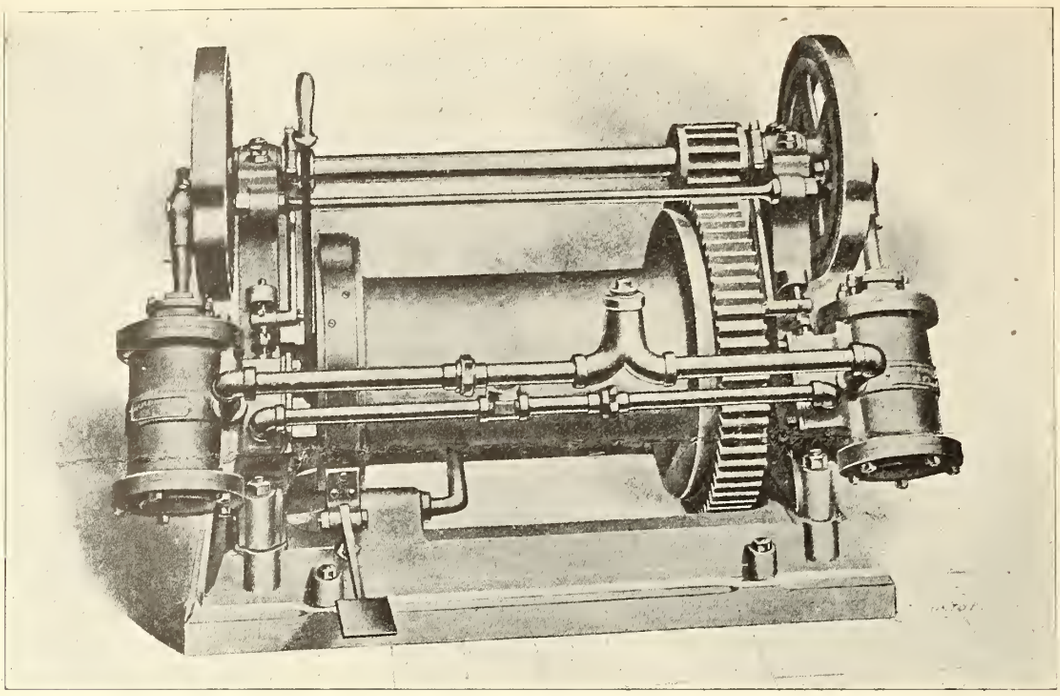


FIG 9—Type of Hoisting Engine in service at the Knob Hill and Ironsides Mines, B.C.

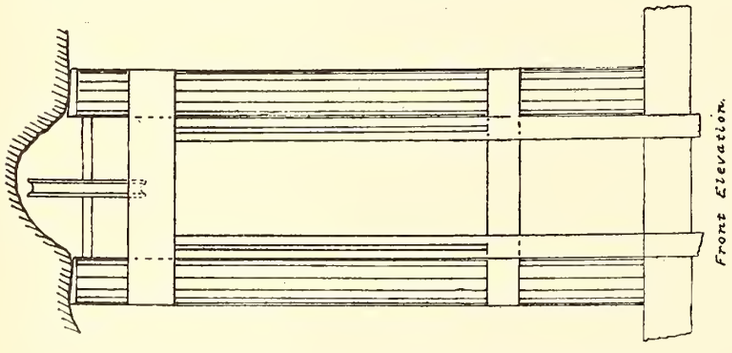
2 x 12 inch plank. The foundations are mudsills with two long sills beneath the hoist. The chamber is dry and no better roof is required.

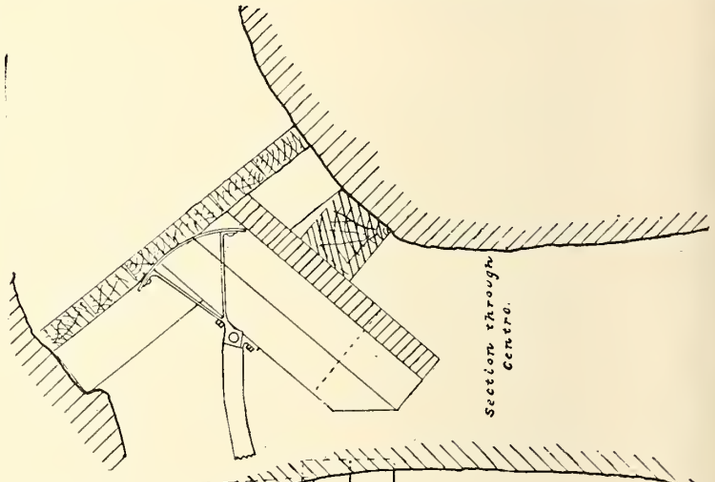
Fig. 13 shows a hoisting arrangement used on the surface of Knob Hill for loading ore into the railway cars direct from the surface.

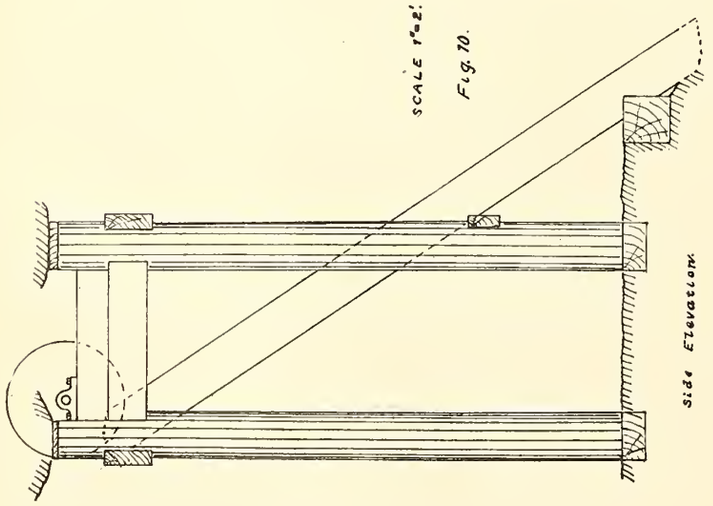
A small car is used running on a 30 inch gauge track, and a small hoist run by air pulls it up the incline, when at the proper place it dumps its load automatically into the moveable shute below which throws it into the railway car standing alongside. The whole hoist rests on mudsills and can be turned to face different parts of the bank from which the ore is being taken. It is steadied by guy ropes reaching from the top to any convenient anchor.

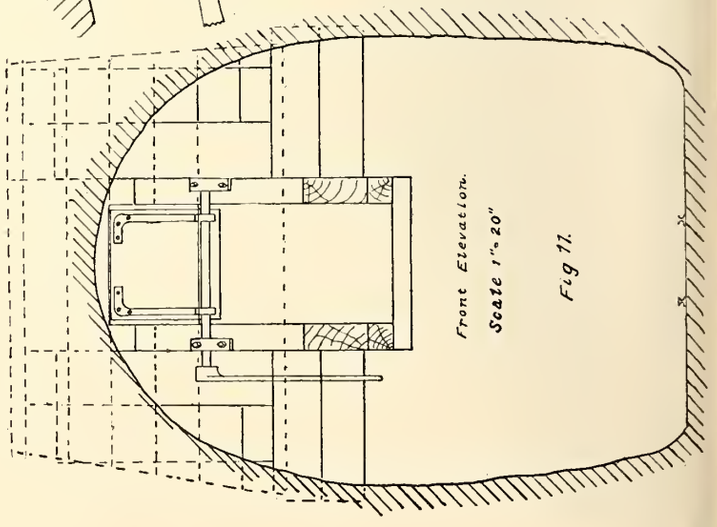
On the whole very little timber is used in the Knob Hill, a few tunnel sets being practically all outside of the winzes, shutes and underground station. The tunnel sets are 10 feet wide by 7½ feet high, California sets.

Timber used in the Knob Hill may be used repeatedly until worn out; but the life of timber in the Old Ironsides is not expected to be









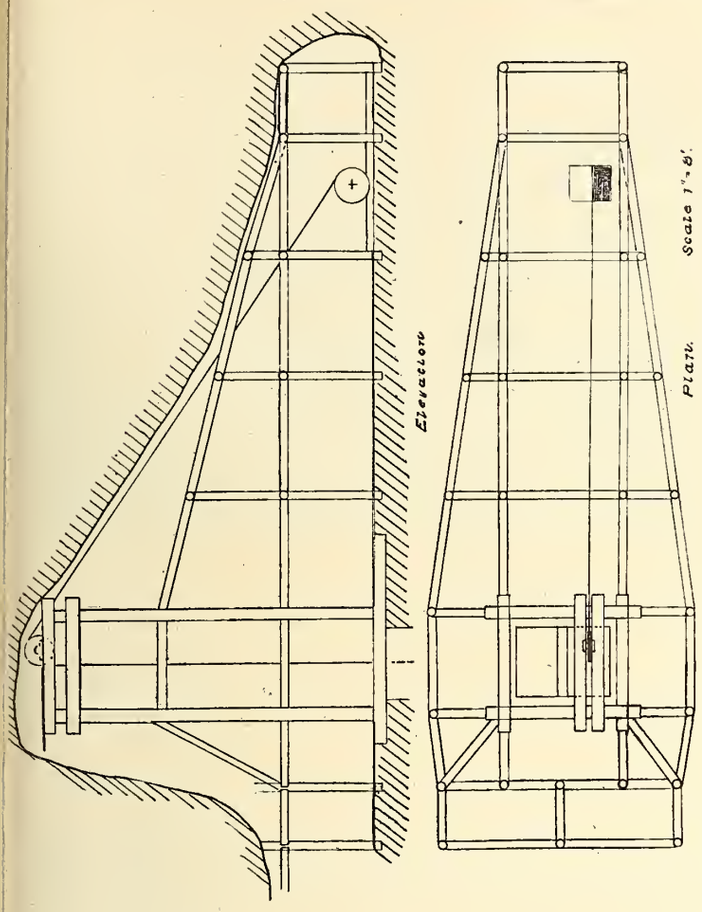


Fig. 12.

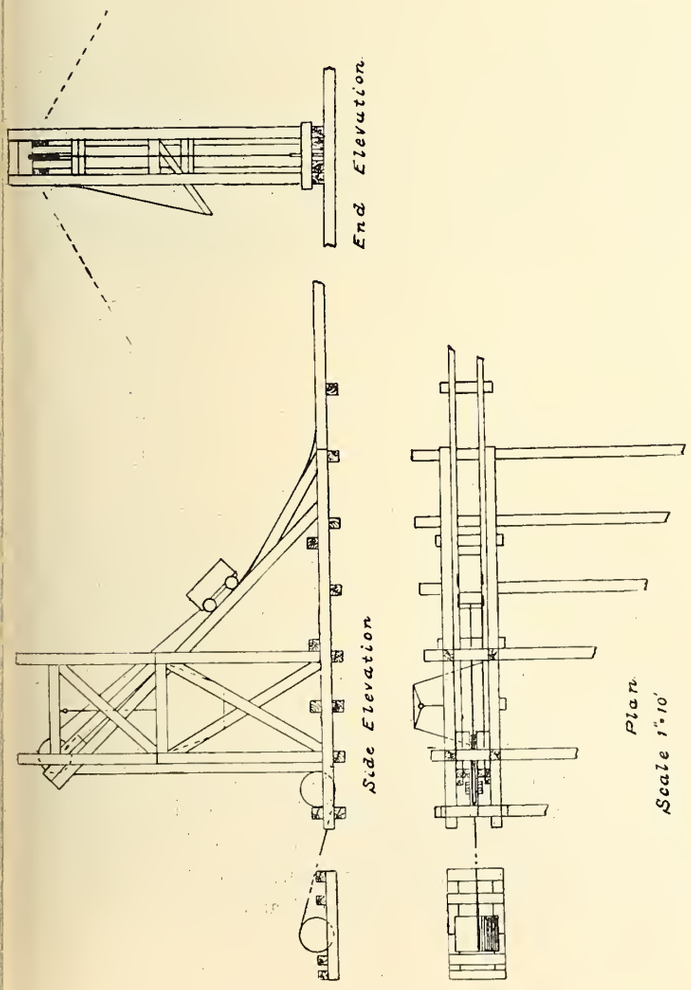


Fig. 13.

more than three or four years on account of the water and great quantities of powder smoke.

A timber crew in the Old Ironsides consists of four men, of whom two at least should be experienced men, the others may be laborers, but more expeditious work can be done if they also have had some experience. The speed of erecting stope timbers depends on the location and the condition of the place where they are being put up, if far from the timber stores or near, and whether there is much rock in the way or not. Generally from 6 to 12 square sets of three pieces are put up by each crew in 8 hours.

Tools required by a crew consist of: 2 sharp axes, 2 older axes, 6-ft. crosscut saw, hooks, crowbars, hammers, picks, shovels, spirit level, straight edge, and a few drills, besides tools used about hoisting engine.

The framing carpenters on the surface require cant-hooks, 8-ft. crosscut saws, hand saws, adzes, axes, squares, templates, straight edges, plumb bobs, chalk lines, grindstone and whetstone. As a rule the underground tools are sent to the surface to be sharpened.

The regular timbermen get $3.50 for 8 hours shift, laborers $3.00; and the foreman who looks after all the crews gets $4.00. The framing carpenters get $4 00 per day, but work 10 hours per day.

Figures of the cost of mining have not been made public. Any attempt to figure the cost of timbering in a mine must be made from figures got during a period when the conditions have been very nearly the same; as this has not been the case here owing to changes in the labor and in the source from which the timber has been got the figures would be of little use.

The drawings of timber from which the accompanying photographs were taken were made by the writer from measurements and notes taken by him at the mine.

The paper refers to the state of affairs at these mines in June, 1901.

Mining in the Rossland District.

By C. M. Campbell, McGill University, Montreal.

This paper will deal chiefly with the mining practice in the Rossland district. The history of the district will be briefly sketched and its geology noted at some length. The larger part of the information herein contained I gathered last summer, in Rossland and the surrounding country, during the stay of the McGill Summer School in that district; and later, while engaged as pipeman's helper and as machine man in the Centre Star and Le Roi mines. In addition to this I have drawn on an article by Mr. Brinsmeade, B.S., M.E., in "Mines and Minerals" for March, 1901, for much additional information. For the geology of the district I am indebted to a geological excursion with the McGill party under Dr. Adams, to the Government reports, and also to the expert evidence of Mr. Clarence King in the Centre Star–Iron Mask law suit. The negatives from which the micro photos were taken were kindly loaned by Mr. O. E. Le Roy, B A., of the McGill Geological Department. The remaining photos I took while in Rossland, and they represent the condition of affairs at that time. The Toronto "Globe" of Feb. 8th, 1896, is my authority for the historical sketch.

By the Rossland district is meant a piece of territory on both sides of Trail creek, about three miles wide and eight long. Trail Creek is an average sized mountain stream which flows into the Columbia River from the west, six miles north of the International Boundary. The creek was known to placer miners in the early sixties, as the celebrated Dewdney trail followed its course from mouth to source, but it is not known whether these early pioneers ever found evidences of the richness of the camp or not. In 1889 a French Canadian named Bordeau made the first location, some distance south

of Red Mountain, and next summer two men, Moris and Bourgeois, staked out the Le Roi, War Eagle, Centre Star, Iron Mask, and Virginius claims. Every one of these claims has since been made a mine except Virginius, upon which little or no work has been done. Things went slowly until 1895, when there were only a few dozen log cabins in the camp. Then the boom struck the place, and the population went up to 2,500 in the course of a year. Since then the growth has been steady, and Rossland has now a population of over 7000. It is entirely a mining town, the people being completely dependent on the mines.

GEOLOGY. (SEE MAP.)

Many ore deposits, such as the famous Cripple Creek deposits, are situated on deeply eroded volcanoes. At Rossland we have another example of this. Here we have an igneous core, on the sides of which we find piles of ashes and lavas, all very much compacted.

The rocks of the igneous core are of different types. One, which forms the greater proportion of the mass, and is the country rock of most of the mines, is a dark, greenish or gray, tough, fine or coarse grained rock consisting of black augite crystals and light colored orthoclase and plagioclase feldspars, with usually a little biotite and often magnetite and pyrites. It is an augite diorite, and is the variety known as mongonite. Photo I shows a thin section of this rock magnified. The large crystal is augite, and the dark zone about the edge shows where it is altering to hornblende. The opaque inclusions are magnetite, while the crystal to the left of the augite one is biotite. At the Iron Horse is a darker series of rocks, similar to the above, but without the orthoclase. This rock is gabbro, and in this locality shows a somewhat banded structure, due to the dissolving out of the dark augite or hornblende constituents, and the deposition of silica in their place. This is shown in Photo V, the upper lighter portion of the photo being the silicified part, while the lower half consists of the original mineral. A still further type of rock is that known as augite syenite, and an exposure is to be found at the big cutting at the west end of Columbia Avenue.

Outside this igneous core is the zone of fragmental and volcanic rocks. The fragmental ash rock is a greyish, fine grained, quartzitic looking material, showing a stratified structure due to different depositions of ashes. These features are brought out in Photo II. The volcanic rocks are those known as augite and uralite porphyrites. The passage irom the porphyrites to the gabbros is nowhere sharply defined, and the two rocks have apparently originated from the same magma, but have cooled under different conditions. The gabbros and bordering porphyrites are important from an economic standpoint as most of the ore bodies at present being worked are situated either on or close to their line of junction. Photo III represents a specimen of augite porphyrite taken from this junction. It shows where the dark gray hornblende has been dissolved, and its place taken by the black opaque pyrrhotite. Photo IV shows another section of the same rock as it appears under polarized light. Several twinned augite and feldspar crystals are noticeable.

Beds of impure limestone on Sophie Mountain containing corals and ashes interstratified have been found, and indicate a carboniferous age for the volcano. The whole district is underlain by granites containing beds of limestone and known as the Shuswap series.

The mineral bearing veins are characteristic fissure veins and some of the larger are known as "shear zone" fissures. Instead of being an indefinite amount of parallel fissures extending into the country an undiscoverable distance it is always a zone of a discoverable and limited collection. The mineral deposit may lie on one plane, or they may eat up the rock between the planes and deposit another in its place, or they may occupy the whole zone, or mineralize one particular fissure and travel on that, and so on. The exterior boundary is assignable if you crosscut. These veins are of enormous extent in some places, such as 100 or 200 ft. in width in the shattered mineralized zone.

The ores consist principally of sulphides of various metals. Of these pyrrhotite is by far the most abundant. It is found as a rule in a massive condition, ranging in texture from a fine to medium grain, but is also disseminated through the country rock. The massive variety usually holds blebs of quartz and grains and irregular patches of other sulphides. The pyrrhotite contains gold and silver in varying quantities, a small percentage of nickel, and traces of cobalt. The gold contents are exceedingly irregular ranging from traces up to several ounces to the ton, and the silver from traces to four or five ounces to the ton.

The pyrrhotite is usually accompanied by a certain amount of copper pyrites, intimately commingled with it. The copper pyrites is extremely irregular in its distribution, in some places constituting a considerable portion of the ore body, and in others occurring only as isolated and occasional grains and patches. It is nowhere seen in large masses. It is auriferous, and holds apparently about the same percentage of gold as the enclosing pyrrhotite.

Molybdenite, galena, and blende also occur in some places in small quantities, while iron pyrite is met with in greater or less quantities nearly everywhere. The ores are usually oxidized on the surface, but the alteration seldom extends downward for more than a few feet.

DEVELOPMENT.

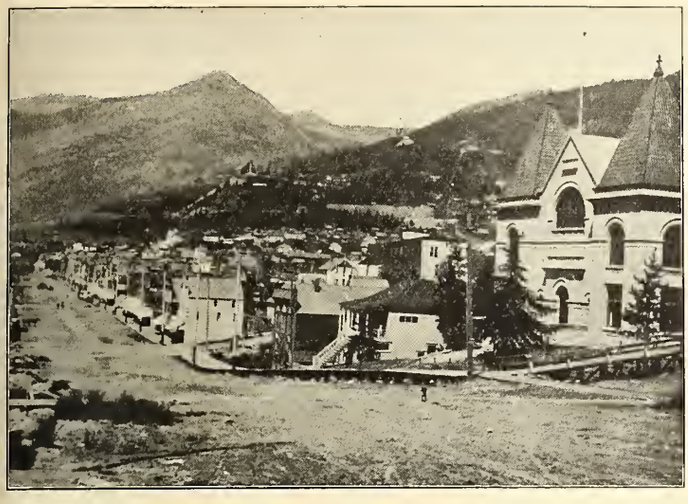
The mines have been developed by running inclines along the dip of the vein, and from these inclines driving horizontal drifts at 100 foot intervals along the strike and usually within the walls of the vein. These drifts are afterwards enlarged, sill floors put in, timbered, and the ore in this way worked out to the next higher level.

DIAMOND DRILLING.

In the big mine diamond drill outfits are constantly kept at work exposing the deposit. Two sizes of drills are used, one with a bit of 2⅛ in. outside and 1⅜ in. inside diameter, and the other with 1½ in. outside and 15/16 in. inside diameter. In starting the drill, especially from those drifts in which tramming is being pursued, a short crosscut is first made by the percussion drills to give a space for the machine and the proper handling of the rods. The rods are square threaded at the ends and come in five foot lengths. They are pulled in lengths of 5 to 20 feet, according to the space available behind the drill.

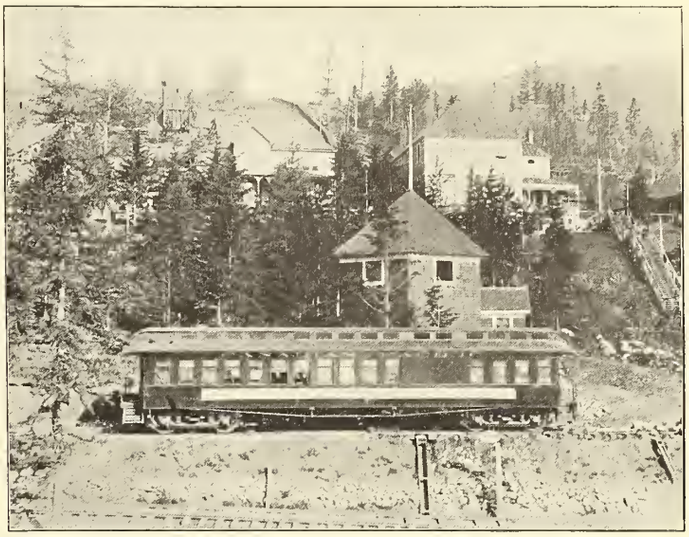
The holes are cored throughout. The core barrel is 5 feet long, and the frequent slips and small seams in the country rock, permit the cores procured to be easily broken off by the usual choker device. The average length of the pieces of core is 5 to 8 inches. In careful sampling the core barrel is sometimes pulled out for every six inches advanced. The drilling engines are screw fed, and fitted for 300, 700, and 1000 revolutions per inch of advance. Their ordinary speed is 300 revolutions per minute. The water is pumped through the drill rod by a small independent pump run by compressed air. The average progress is 8 feet in an eight hour shift, with a record of 18 ft. 9 in. The core is broken up and assayed, after a careful examination by the mine superintendent While drilling in ore, sludge samples are taken by running the discharged water for a fraction of the time into a tin pail, in which the sludge settles out.

The Rossland rock is very hard on diamonds. The War Eagle and Centre Star companies employ a skilled bit setter to keep the bits in running order. For the smaller sized bits eight diamonds are used, six on the face and two on the outside. Those on the face are set so that half of them have a cutting edge extending to the outside of the face, while the other half cut the inside clearance for the core to pass up. Whenever the drill is withdrawn from the hole the bit is always carefuliy examined, and if any of the diamonds are found to be loose



Le Roi. Gertrude. War Eagle. Centre Star.

Rossland.



War Eagle Tram. Manager's Residence. W.E. and C.S. Offices Reservoir.

Offices War Eagle and Centre Star.



Rossland from O.K. Mountain.



Shaft House. Engine House. Aerial Tramway. Bins. Air Compressors. Black Bear Tunnel. Boiler House. Ore Cars.

Surface Plant Le Roi.



Le Roi Offices.



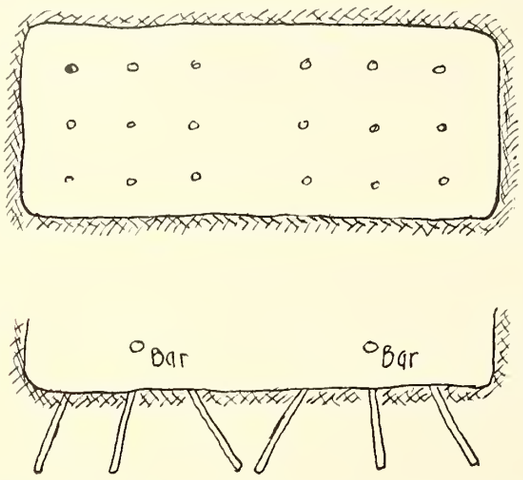
Le Roi Ore Bins.

or the metal worn away, the metal is recaulked around them. When the bit is so badly worn that the diamonds are greatly exposed, they are cut out and reset in a new metal blank.

The wear of carbons is somewhat less than 1/64 karat per foot of hole drilled. Each bit will only drill about 12 feet before resetting. To remove a bit that has been broken off in the hole, it is sometimes necessary, if other devices fail, to ream out the whole with a new bit, large enough to enclose the stuck bit and recover it in the core barrel.

SHAFT SINKING.

The Centre Star shaft is 18 ft. 4 in. x 7 ft., outside to outside of timbers, and is on an incline of nearly 70°. The accompanying figure shows the position of the drill holes for sinking. The whole round is drilled before any blasting is done, the machine drills being set up as shown by the location of the two bars. Four men work the two machines, and it usually takes two shifts to drill the round of 18 holes.



The machine men do their own loading and blasting, as it is impracticable to have a separate gang for blasting in the shaft as in the stopes and drifts.

In the Centre Star shaft the rock is hoisted, during sinking, by a bucket let down from a sheave in the ladder compartment by a small Ottumwa Ironworks Company's friction hoist in the station above. An iron bucket is used, 42 in. long and 36 in. greatest diameter. The bale is made of 1 in. round iron with a loop for the clamp hook. A couple of lugs of 1 in. round iron, spread out at the end into a square plate, are riveted to opposite sides of the bucket near the bottom. The bucket runs on skids about 20 in. to 24 in. apart, on which strips of greased strap iron are nailed with the flat side tangent to the bucket at point of contact.

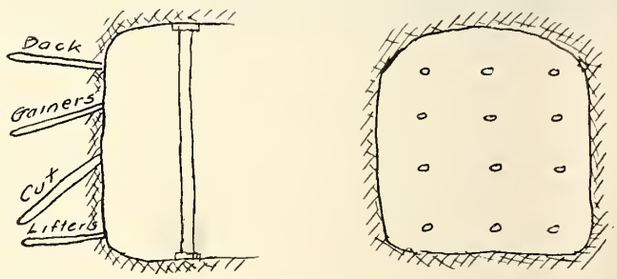
Near the point of dumping two outside skids are placed a little farther apart than the diameter of the bucket, and take the place of the other skids. These catch the lugs on the bucket and straighten it up. At the point of dumping two depressions are made in the skids and the bucket is only hoisted high enough for the lugs to catch in the depressions. The engine is reversed, lowering the top of the bucket, which falls backward and dumps. The bucket is then hoisted a foot or so above the depressions, and is lowered, the lugs catching on swinging irons which swing forward by the weight of the bucket, carrying the lugs over the depression. The bucket is then lowered to the bottom and refilled. The plan of the 600 level shows the position of the hoist and the shaft. The bucket is dumped backward into a car standing on the track behind the shaft. Two bucket loads fill the car, which is then wheeled around to the front of the shaft, and the contents dumped into a skip.

The old rock bulkhead method has been abandoned in favor of the timber bulkhead. By this method the timbering goes on contemporaneously with the sinking, sufficient space being left to keep the lowest set from being injured by the heavy blasts. This clearance is usually 20 to 23 feet.

The shaft sets are of sawed pine, framed on the surface, and are placed 5 ft. apart, being separated by posts. The way in which the different parts fit together is shown in the timber drawings. Hangers are employed to support the sets as the work progresses, the posts serving to keep the sets properly spaced, while the hangers keep the sets tight against the posts. They are not left on permanently, but are removed after several sets have been completed and properly wedged in position.

DRIFTING.

Where possible the drifts are driven along the hanging wall so as to have one free face to break from. The sketch shows the position of drill holes in drifting. The advance per round of holes is about 3½ feet. The powder used is 60% dynamite for primer cartridges and 50% for the balance of the explosive ; 40% is used if soft rock is struck.



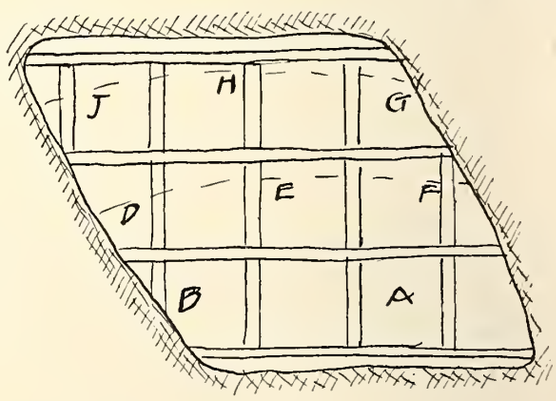
Ten and a half pounds of powder was the average consumption for one foot advance for a recent period. In Rossland the muckers and trammers receive $2.50 per day, and the machine men $3.50, when working by the day. It is, therefore, more economical to keep the machine men constantly drilling, and leave the loading and tramming to the muckers, and this arrangement is followed out.

RAISING.

The raises are put in at irregular intervals. In the Centre Star there are not half a dozen, all told. They usually have two compartments, one a man-way and the other a chute.

TIMBERING.

The square set method has been adopted, and is worked as shown in the sketch. The drift A having been driven, the breast stope A–B is then completed to the height of the curve D–E–F. Sills and then square sets, framed on the surface, are put in and floored over by four



inch plank. This timbering is shown in detail in the drawing. The drill columns are then set up and stoping is pursued to the curve J.H.G. when the next floor of square set timbers are inserted. Enough space is always first excavated above last floor put in to give room for drilling. The broken rock is taken by wheelbarrows to chutes boxed in among the sets at 50 foot intervals along the foot wall. The method of timbering a tunnel is shown in the photo of the abandoned Mugwump mine.



War Eagle. Josie. Le Roi.

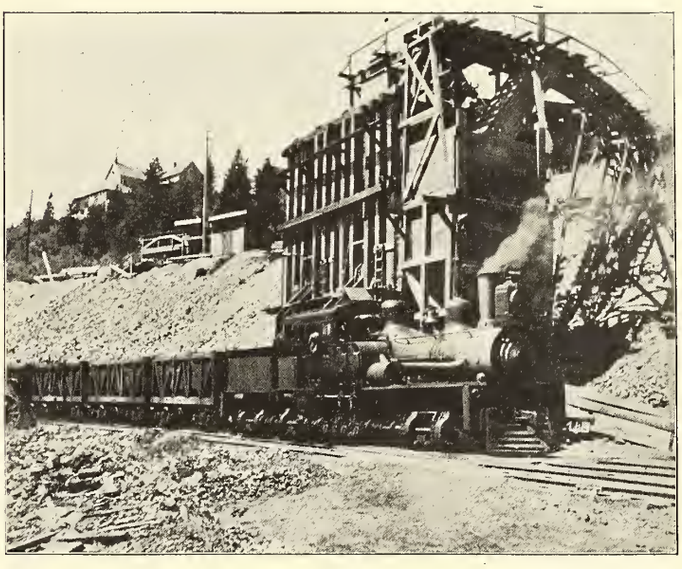
Looking East from Le Roi Flume.



Old Surface Works Centre Star.



Roast Heap Trail Smelter.

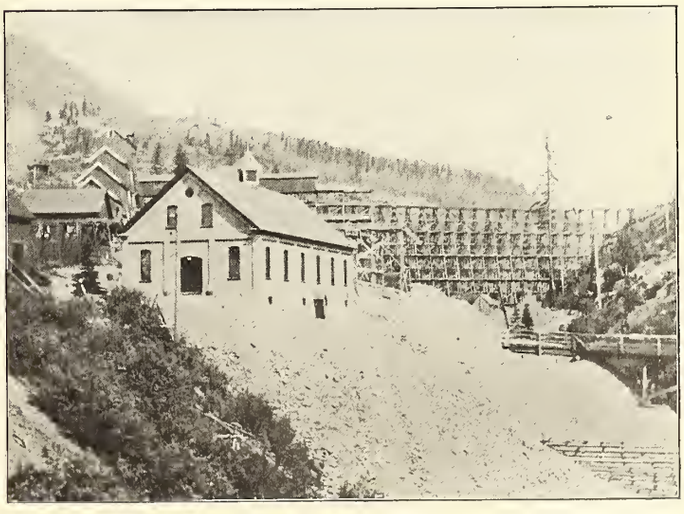


Shay Locomotive at War Eagle Bins.



Bins. Boiler House.
Lumber Yard. Carpenter Shop. Shaft House. W.E. Tram.

Surface Plant Centre Star.



Shaft House. Air Compressor. Iron Mask Gulch.

Nickel Plate Mine.

BLASTING.

For cleaning out downward drill holes for loading, a straight blow-pipe made of one inch pipe is used. This pipe is connected to the air supply, and thus makes an efficient tool. Powder is kept in a powder house near at hand. A thawing temperature is maintained by hot water pipes heated by a stove in an adjoining cabin. A powder-man watches the powder-house and keeps account of the powder distribution. In the mine workings above the lowest tunnel it is, in winter, nearly as cold as on the surface, and the powder, if left long before firing, would soon freeze again.

TRAMMING.

Three types of stations are in use (See drawings of shaft stations). One with a shaft bin; one with a chute which discharges the ore directly into the skip; and one where the cars are dumped directly into the skip. The wooden hopper used in this case usually prevents



Phenocryst of Augite in Monzonite from boulder near War Eagle Stairs.

the rock from falling outside the skip when dumping the car. A lessening of the number of cars required for tramming is one of the benefits gained by the installation of the station bins. This method is used altogether at the Le Roi and works very satisfactorily. Here the bins are much larger than those at the Centre Star, the one on the 700 level holding 350 tons of ore. The gates of these bins are worked by compressed air cylinders. By this method the skips can be loaded much faster and less dangerously.

The tracks are 15 lbs. per yard, and are spiked, in the drifts, to ties 2½ feet apart. Various types of switches, in and about the mine, are shown in the sketches.

The mine car in use in the chief mines is 2 ft. 11½ in. from track to top of body, and has a capacity of 16 cubic feet of rock. The turn-table on the truck allows it to be dumped in any direction.

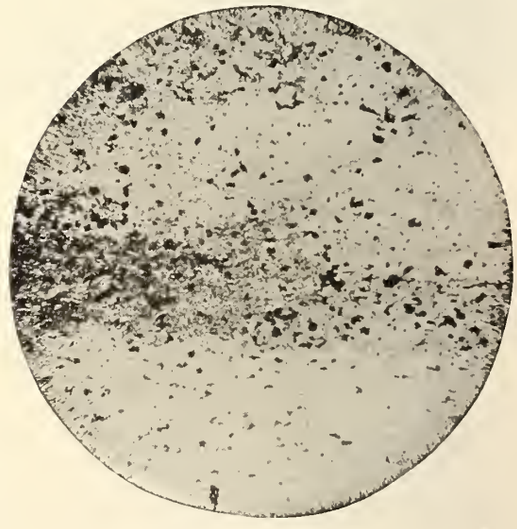
The axles are of the Anaconda type. In this type the axle is divided in the centre, mainly to allow for variation of travel in passing around curves, also to enable the wheels to be pressed separately on each half axle. This construction simplifies repairs, does away with nuts and caps on the outside, and necessitates oiling only once in three or four weeks.

HOISTING.

At the Centre Star shaft there is installed a steam hoist made by Webster Camp and Lane, of Akron, Ohio, with two drums, each 6 ft. x 3 ft., with a capacity of 1700 ft of rope of ⅞ in. diameter. The average winding speed is 800 ft. per minute, with a maximum of 1200 ft. All the motions are controlled by hand levers except the steam drum brake. This consists of a governor which is connected with the shaft. When the wheel goes too fast, the governor allows compressed air to enter a cylinder, which causes a brake to press on the wheel. When the speed passes 900 ft. per minute this mechanism comes into play. The engines are 14 in. x 18 in. stroke, with a Stevenson reversing gear. A Lane friction clutch permits of either drum being run independently of the other; a necessary thing when there are several levels from which hoisting is done. The War Eagle has a duplicate of this engine in its main shaft. The round rope is prevented from cutting the foot wall shaft timbers by rollers on the wall plate at long intervals.

The skip used in the Centre Star and War Eagle Mines is detailed in the drawing, and is also shown in the photo of the Centre Star shaft at the surface. It runs on a 30 lb. per yard steel track spiked to the footwall plates in the shaft. The shaft guides are chiefly for safety purposes, for the skip dogs will grip them in case of accident to the rope. The guides also serve to keep the skip steady, as the skip body is only fastened to the frame on the rear axle. The weight of the skip is 2,400 lbs., and as it carries a load of 4,600 lbs. the total weight of the loaded skip, without the rope, is 7000 lbs. It is proposed to increase the hoisting capacity when it becomes necessary by attaching a cage under the skip. The skips in these mines are equipped with a Humber safety clutch, the working of which is seen on reference to the drawing. The clutch is designed to prevent accident due to overwinding of hoisting rope, which may occur from carelessness of the engineer or derangement of the engine. Without this hook the cage may be drawn up to the head sheave, causing the rope and possibly the sheave to break. Figure 1 of this drawing shows the hook closed at the top, as it would enter the stationery safety-stop when overwinding occurs. Figure 2 illustrates the action. Having, by overwinding the hoisting rope, come in contact with the safety stop, the spreading plates, one of which is shaded in the drawing, close at bottom, causing their upper portions to open like scissors, releasing the rope. At the same moment the plates spreading at the top, drop, and rest on the safety stop, thus suspending the cage until the runaway rope is again attached.

The War Eagle steam hoist replaced a 300-h.p. electric hoist run by the current brought from Bonnington Falls, 30 miles away. The



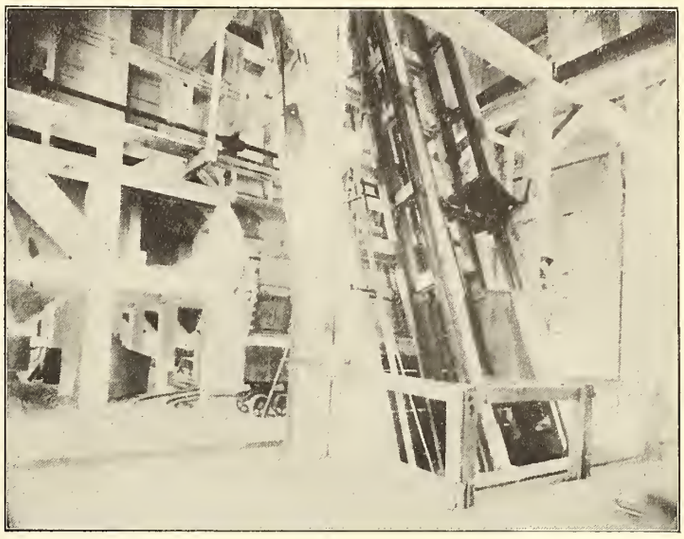
Ash Rock from California Mine.

electric hoist was a failure, owing to bad design and faulty construction. A good example, however, to show that an electric hoist of correct construction will work acceptably, is the one recently installed at the Josie shaft, made by the Denver Engineering Co. It is a 150-h.p. machine, with an average consumption for counterbalanced hoisting of 60 h.p. It works at a potential of 250 volts with a three phase motor; and has two drums, each holding 1000 feet of rope.

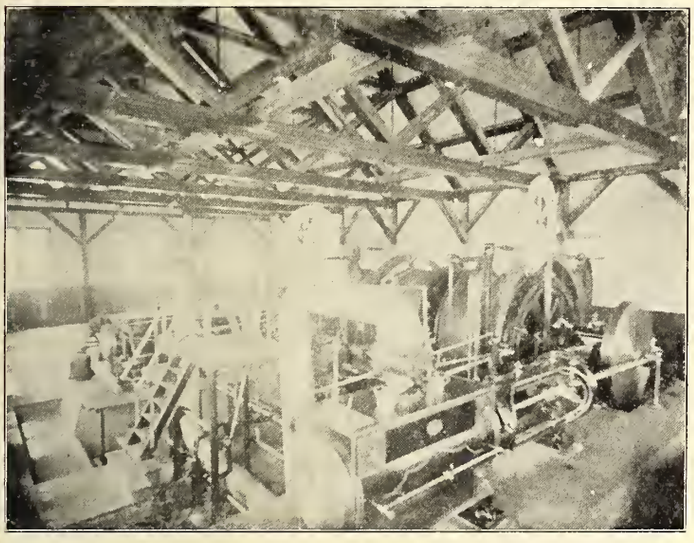
In the Le Roi five compartment shaft two of the compartments are



Mugwump Tunnel (abandoned).



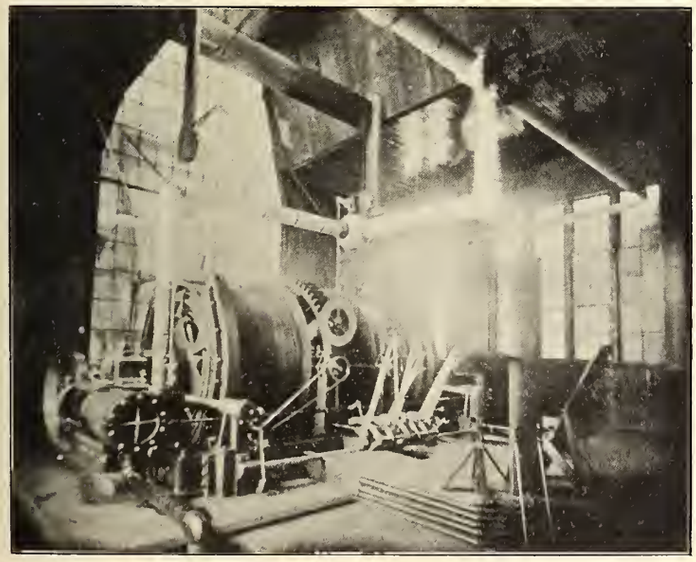
Shaft at Surface, Centre Star.



Hoisting Engines, Le Roi.



Shaft at Surface, Le Roi.



Hoisting Engine, Centre Star.



Shaft at Black Bear Tunnel, Le Roi.

used for hoisting ore. The skips in use are much the same as above described, but as men are not hoisted in them the bonnet has been omitted. Below the surface these two compartments are boarded in. Cages, with two decks, are used for hoisting the men, and these run in two other compartments, the fifth compartment being the ladder way. Before long, cages with three decks will be used. One of these is shown in a photo. It is lying outside the entrance to the Black Bear tunnel, prior to being mounted in shaft Separate engines are used for the ore and man skips. The hoisting signals are a combination of pull rope and electric bell.

In most of the large mines there is a telephone connection at each level with the surface. This is found to be a very great convenience.

VENTILATION.

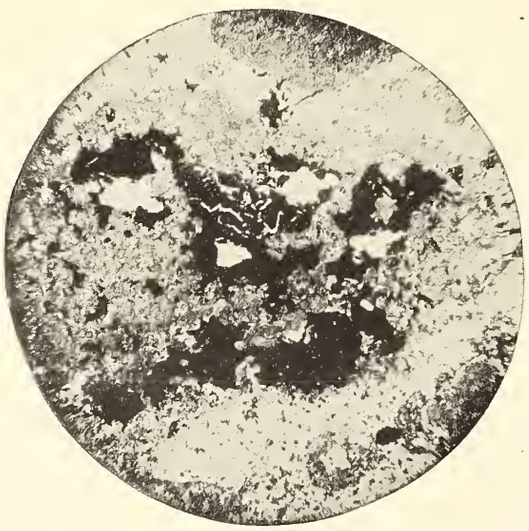
This is chiefly natural. In long drifts ventilation is produced by means of a Root blower. This is on the surface, is usually worked by a motor and blows a positive current down a main set in the ladder-way of the shaft. This main is round, of galvanized steel, and is riveted and soldered with telescopic joints Branches of smaller piping are taken off at each level where necessary and led into the working faces.

PUMPING.

As yet the water encountered in most of the mines is insignificant. In the Centre Star the water which accumulates on the 200 level is run out of the tunnel on this level. The water of the 300 and 400 levels runs into the sump on the 500 level, and from there an overflow pipe takes it to the 600 level, from where it is pumped by a Cameron sinking pump to the 200 and from there runs out the tunnel.

BLACKSMITHING.

There is no hand drilling, except by the timbermen to cut hitches for placing stulls, or by the pipemen when a hole is needed in the



Augite Porphyrite from War Eagle, showing replacement of Hornblende by Pyrrhotite.

rock for a hanger to support pipes. The hardness of the rocks renders picks of little use. There remains little to be sharpened but machine bits, which are made by welding a star steel point to an octagon steel shank. Each machine drill uses from 20 to 30 bits in eight hours.

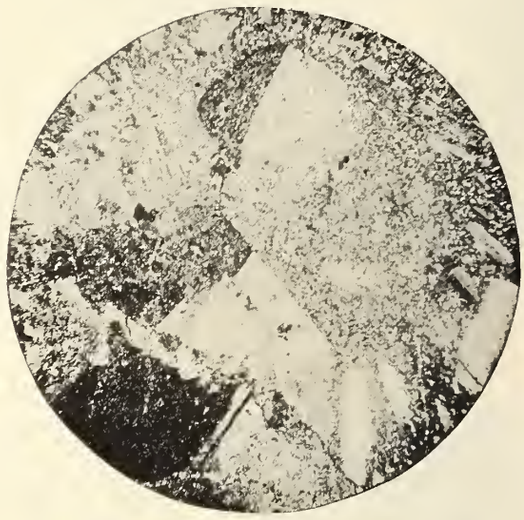
LIGHTING.

Tunnels and stations are lit with 16-candle-power lamps, furnished with horizontal tin reflectors painted white inside. At the working faces candles are used.

HEAD FRAMES.

At the War Eagle is a large structural steel headframe, very expensive, as it was imported from Eastern United States, necessitating heavy freightage and duty. Hence the new frames at the Centre Star and Le Roi are built of timber, the native woods being peculiarly adapted for this purpose. In the Centre Star the hoisting engine is set on the hang wall side of the inclined shaft; this simplifies the head frame, as the posts in the direction of the shaft act as back braces for the frame.

The Le Roi head frame is much larger than either the War Eagle or Centre Star. This is due to the fact that the Le Roi has a larger shaft, and that the building is used for other purposes. The ore from



Augite Porphyrite from War Eagle crossed Nicols.

the skip passes over a large grizzly to a large sized Comet crusher. From this it is discharged on an iron travelling picking belt. The useless rock is thrown into the chutes along the side of the belt, while the good ore goes to the bin beside the loading end of the tramway.

SURFACE TRAMS.

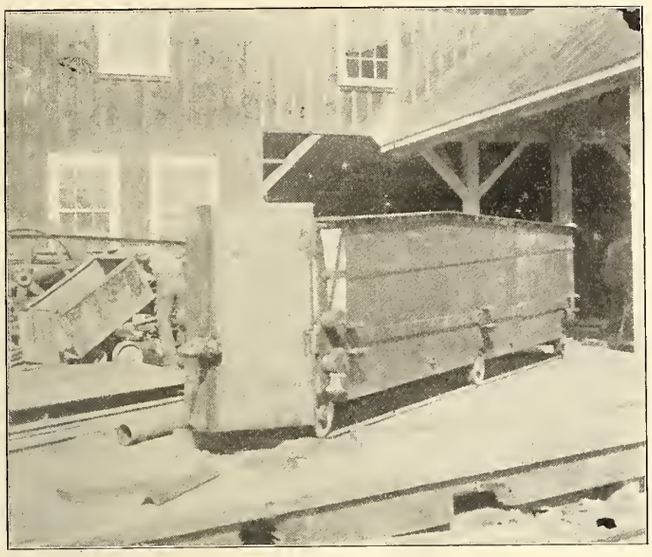
To transport the ore from the main shaft to the shipping bins at the railroad, the War Eagle employs a double track gravity tram. This tram is set for nearly its whole length on a trestle, not to save grading, but to escape the snowfall. The tram has a fall of 350 feet in a total length of 1300 feet, and in profile has a concave and convex curve. The rope is kept down on the concave side by a pulley in an overhead frame, and kept up on the convex curve by a sheave of 4 ft. diameter set between the tracks. The tram car holds five tons of ore, and is dumped automatically at the lower end of the tram. This end of the tramway is moveable, and can be so swung that the end is over the bin into which the ore should be dumped.

The tramway at the Le Roi is an aerial one, about 2000 feet long. One man only is employed at the loading end. At the other end the buckets drop their ore into the bins automatically. From the bins the ore runs into the cars below through iron chutes, the gates of which are worked by compressed air cylinders.

In the Centre Star the ore is trammed in the ordinary manner from the bins in the head frame to the bins along the railroad track, through a covered double tracked passage way a distance of 200 ft. This arrangement is temporary, as it is expected that a concentrator will be erected in the rear of the present head frame, when other loading arrangements will be made.

THE WAR EAGLE STEAM LINE.

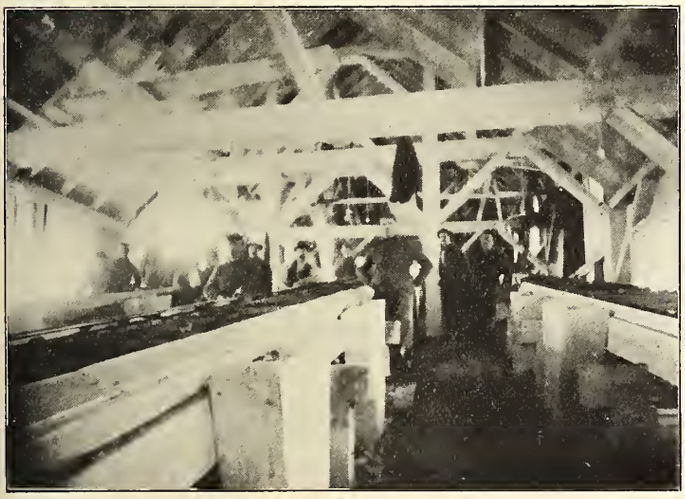
Steam is transmitted through a six inch pipe from the boiler house of the Centre Star up the slope of the hill to the War Eagle shaft house. A section of the wood box enclosing the pipe is shown in a drawing. The pipe is set well above the bottom, to allow for drainage and packing. The packing used is dry coal ashes. When on the



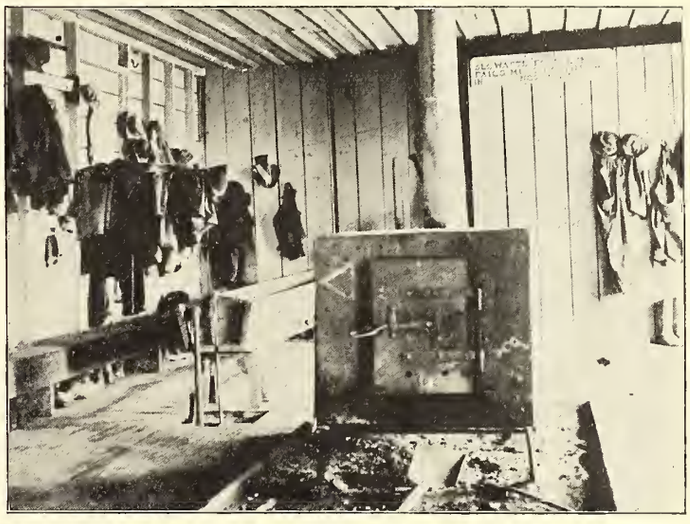
Three Deck Cage, Le Roi.



Dry Room, Le Roi.



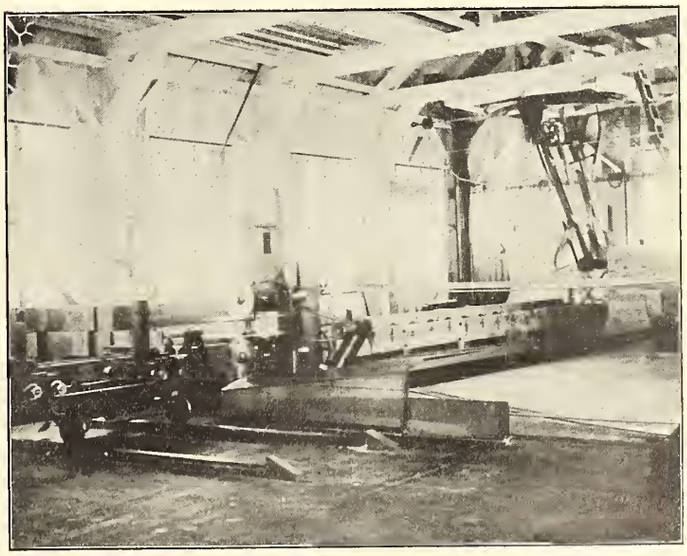
Picking Belt, Le Roi.



Dry Room, Centre Star.



Mt. Roberts. Le Roi Flume.



Carpenter Shop, Centre Star.

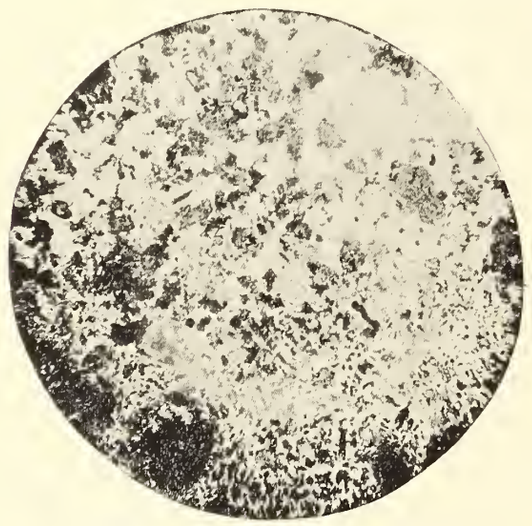
surface the box is naked; but for part of its length it lies underground, and is there enclosed in a wooden conduit large enough to permit the free entrance of a man. Considerable steam is no doubt wasted in this length of pipe, but it is certainly cheaper than the difficult transportation of coal to a separate boiler plant.

STEAM PIPES IN BLACK BEAR TUNNEL.

In this tunnel two pipes, 8 in. and 6 in. diameter, convey the steam 3000 ft. from the boiler-house to the Le Roi head works above. The temperature of the steam inside is 480°, but the insulation is so good that the outside is only warm. To bring this about several layers of packing were used—first, air cell asbestos covering, with air cells rnnning lengthwise, then ½in. strips of wood set at right angles. This gives an air space of ½in. Then same type of covering as first, except that air cells run around the pipe, and finally, a thorough coat of lime whitewash to close the pores. As expansion and contraction amount to considerable in a pipe line like this, siphon joints are inserted every 200 feet. These are well packed, and will allow a lengthening of 14 in.. though only about one-third of that is ever used.

SURFACE PLANT.

A short description of the Centre Star surface plant might be introduced here. The chief difference between the one at the Centre



Altered Wall Rock from Iron Horse.

Star and the one at the Le Roi is that the latter is slightly larger, otherwise they are very similar. As for the War Eagle, most of the surface work required is done in the Centre Star shops.

CARPENTER SHOP.

To the east of the shaft house is the carpenter shop. This building is equipped with a 40-inch swinging cut-off saw, run by a 30 h.p. electric motor placed overhead on the turntable from which the saw hangs. It is arranged to turn by a pinion and gear, and to cut bevels of any angle so that timbers do not need to be moved. A speed of 1800 revolutions per minute is obtained by using the motor. Below the saw is a roller table which runs to a carriage. This takes the timber past four saws which cut a tenon on each end. This machine is driven off a counter shaft, and will cut up 100 sets of timber per day, the work of 50 carpenters by the old method. Square 10 in. x 10 in. timber is used. Some of it is obtained from Nelson, and some from a mill four miles distant. Wedges are cut from 4 in. plank by a solid-toothed buzz saw 24 in. diameter, running 1800 r.p.m. This saw will cut 2200 wedges in 4½ hours. Formerly $25 per thousand was paid for them. Sixty horse-power is used for the shop. Adjoining is a lumber yard, where a well ordered supply of timber is kept on hand.

MACHINE SHOP.

This building is west of the shaft house, and is equipped with a large planer 29 ft. x 24 in., two large 14 ft. 28 in. lathes, and one of smaller dimensions, a Barnet drill and a radial drill with a 6 ft, arm. A travelling crane of 3 tons capacity commands the shop. The master mechanic's office with a drafting table, and the engine room, adjoin the shop. Partitioned off in another corner is the drill and air hose repair shop. This is also a supply room for drills, bars, and drill parts.

BOILER HOUSE.

Eight boilers are installed here. Four are of 80 h.p. each, and have separate smoke stacks. The remaining and somewhat larger boilers have a smokestack for each pair. Crow's Nest coal costing $5 per ton is used.

AIR COMPRESSORS.

One end of the boiler house is used for air compressors. Here five compressors of 7 drill capacity each are stored. They were in use before the large new compressor was bought, and are still used in emergencies.

The new compressor is a Rand compound condensing machine. It is a 200 h.p. 40-drill compressor, and can be run either with electricity or steam. At present it is run by steam. The air is compressed to 35 lbs. in the low pressure cylinder, passed through an intercooler, and then to the high pressure cylinder, where it is further compressed to 90 lbs. The water from the intercooler is passed over a cooling tower, which consists of a series of horizontal troughs (of wood and galvanized steel) that expose the water in thin sheets for partial evaporation in the atmosphere, by which the residue is cooled. This takes the water at 212° and cools it to 90°. Twenty-five gallons per minute are cooled, and the tower is used on account of the scarcity of water.

LE ROI WATER SUPPLY.

The Le Roi Company have a supply of their own. The east fork of Little Sheep Creek has been inverted near the Jumbo Mine by means of a dam and flume, and the water thus taken to the mine is used for the required purposes and then turned into Trail Creek at its head quarters on the Black Bear mineral claim.

DRY ROOMS.

Here the men change their clothes before going in, and when coming out of, the mine. In the Centre Star dry room the trough containing the washing water has a steam pipe running along the bottom. Apertures in this allow the steam to escape and warm the water.

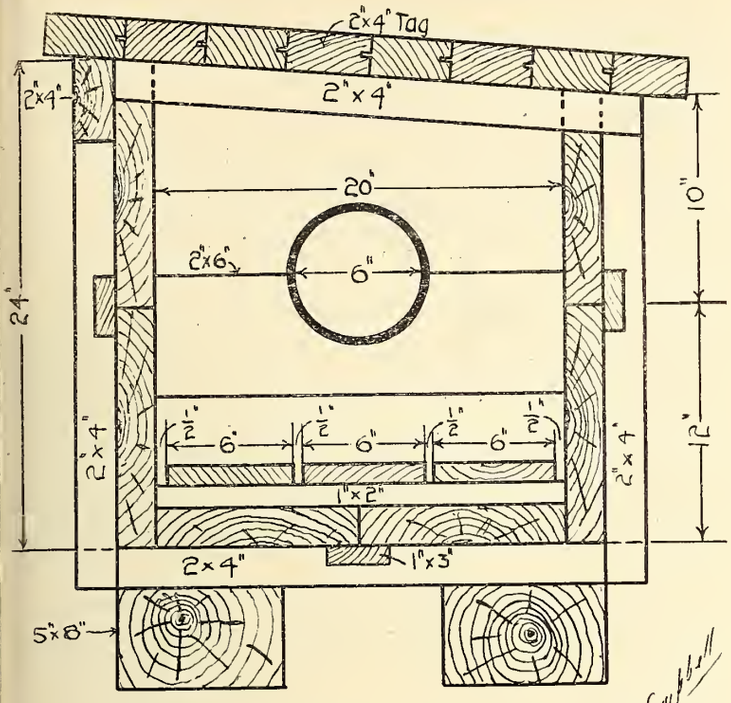
The Le Roi building is somewhat more pretentious. Hot water is supplied in large quantity, and each man can have a wash basin of of his own. The room has a cement floor, and a small stream of water runs along a trough in the floor, carrying off all impurities. Each pair of men can have an apartment to themselves.

BUILDINGS.

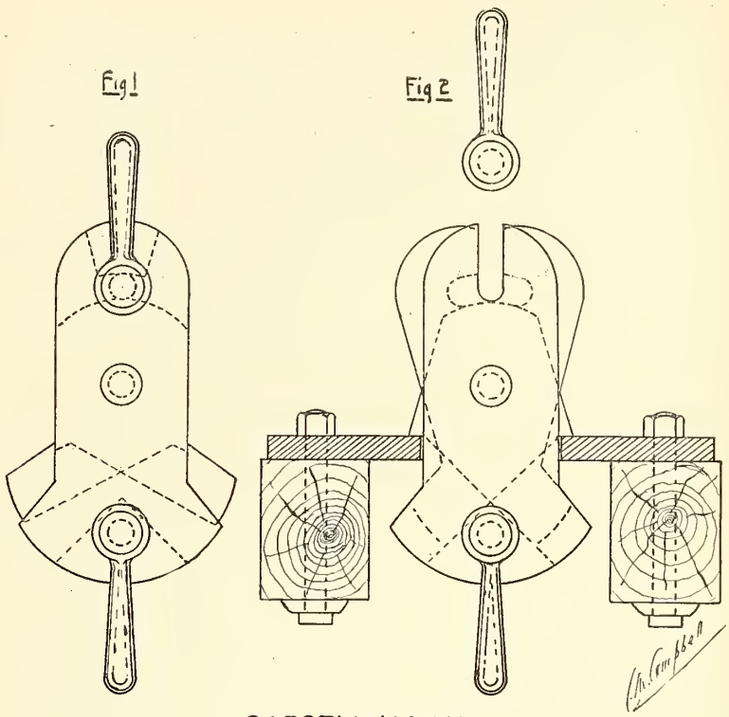
The head offices and other buildings of the mining companies are very tastefully built and are surrounded by well kept gronnds. This is rather the exception in mining camps, and deserves favorable comment.

WORKING COSTS.

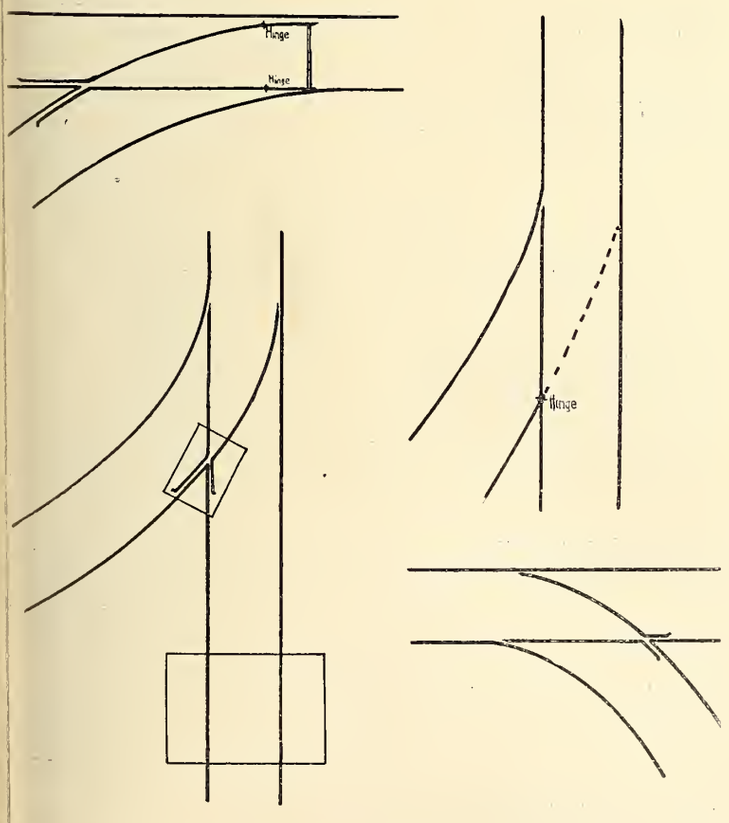
The War Eagle and Centre Star issue a detailed report annually to their shareholders. In this report are shown the general financial balance sheets, the condition of the mine as to ore reserves, and the itemized cost of each branch of work. From the report of 1899 we learn that during the year the total cost of mining per ton of ore stoped was $5.86. To this must be added the transportation charges



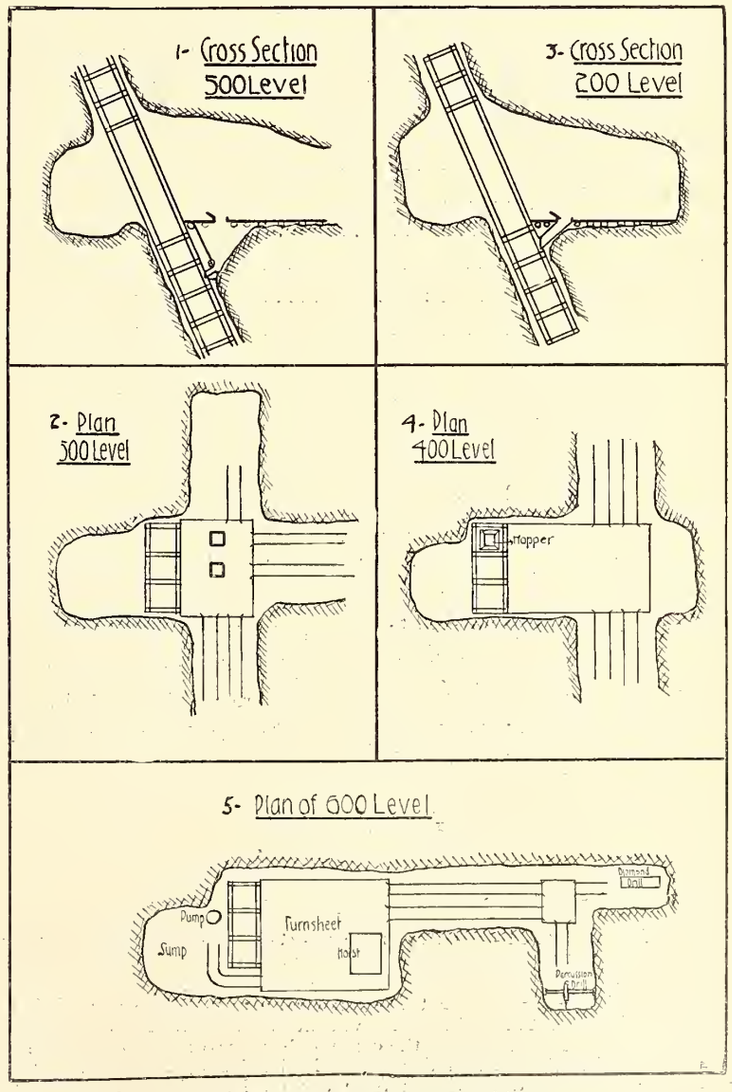
Cross Section of Wood Box enclosing Steam Pipe from Centre Star to War Eagle Mine



SAFETY HOOK



Mine Roads and Tracks



Stations in Centre Star Mine

to the different smelters and the cost of smelting, bringing the total cost up to nearly $11.00.

The Le Roi ore is smelted at their own smelter at Northport. The rest of the Rossland ore goes to Trail, where it is roasted before being treated in the furnaces. The grade to Trail is very steep, and a specially constructed and very powerful stay locomotive is used on the route.

OUPUT OF THE MINES.

For the six months ending June 30 the output has been as follows:

January–June,	1897	30,008 tons
"	1898	39,395 "
"	1899	66,576 "
"	1900	72,080 "
"	1901	204,500 "

The output for the first six months of 1901 was divided as follows:

Le Roi	104,298
Le Roi No. 2	20,270
Centre Star	51,918
War Eagle	19,050
Great Western	8,058
Iron Mask	2,233
I.X.L	189
Monte Cristo	20
Spitzee	80
Velvet	586
Evening Star	74

LABOR CONDITIONS.

Rossland is a union town, the local miners' union being a branch of the Western Federation of Miners. The scale of wages for the leading positions has been:

Shift boss	$5.00
Shaft men	$4 00
Machine men	$3.50
Timber men	$3.00 to $3.50
Shovellers and car men	$2 50
Carpenters	$3 50
Machinists	$4.00
Blacksmiths	$4.00
Blacksmiths' helpers	$3.00
Hoisting Engineers	$3.00 to $4 00
Powder and tool boys	$2.50
Surface laborers	$2.50

Machine men, however, usually work by contract, and are paid according to the total length of holes drilled. Contracts are verbal. Parties are fixed and contracts let at the beginning of each month. The men are provided with a box of tools and a two compartment box for dull and sharp steel. Better wages are usually made by this method, the average being from $4.00 to $4.25. In most cases it is more satisfactory to the employer.

NORTH STAR.

Director's Report for the Past Year.

The following is excerpted from the report of the directors for the year ended 31st May last and submitted to the shareholders at their meeting on 25th ultimo:—

"The directors regret that the extremely unsatisfactory conditions mentioned in the last annual report have continued. To this has to be added a strike of the miners caused by the company's endeavor to bring the wages to a more reasonable scale. This resulted in the closing down of the mine and shipments were discontinued from the 1st December till 10th May. During this time exploration work, with a view to the discovery of additional ore bodies, has been carried on, but the directors regret that the result while encouraging has not brought about the discovery of additional large ore bodies.

The company is still in a strong financial position and dividends have been paid during the year."

MANAGER'S REPORT.

"I beg to submit the following report upon the operations of the mine for the past year.

During the past year there has been driven 3,780 ft. of drifting, cross-cutting, sinking and raising, both in rock and gravel work. In the former the contact of porphyry and the country rock has been followed, since apparently the porphyry is genetically related to the ore. The gravel work is also necessary, since the ore deposits already found have occurred near the surface on the top of the country rock and imbedded in gravel and porphyry.

This year two small ore chutes have been found by following in one case the contact mentioned above and in the other case by cross-cutting in the gravel across the direction of strike and keeping on top of the country rock. No bonanza shoot of ore has been found, although there is every prospect of more being discovered. The ore occurring in well defined channels or routes, when found, is more difficult to locate when lost than would be imagined, but there are certain signs which if noticed carefully from day to day enable us to follow the ore channels even when there is no ore.

Owing to the fact of the area owned by this company being so large it is difficult to cover this quickly. This is best realized when it is known that only 13 per cent. of the strike distances have been developed or even prospected. I refer to the strike distances of the ore channels which to date are three in number. In view of this there are very great possibilities ahead of this property. I think the old channels can be relied upon to yield more ore and that others may be found.

The operation at the mine were interfered with for a period of about two months by a shut down caused by a strike of the miners.

During the year, 5,918 tons of ore have been shipped, the average assay value of which has been 25.4 ozs. of silver and 54.1 per cent. of lead.

At present there is a force of 70 men employed in development, prospecting and stoping

After careful consideration, not of the moment, but of days, and after the experience of this property during the time I have been here, first as superintendent and now as manager, I consider the future prospects of this property as not being unfavorable."

FINANCIAL STATEMENT FOR TWELVE MONTHS ENDING 31ST MAY, 1902.

Assets.

Mines, Mineral Claims and Assets		$1,129,644 89
Permanent Equipment		64,751 43
Office Furniture		870 47
Mine Supplies and Stores on hand, as per inventory		6,798 98
Accounts Receivable		3,139 27
Ore in transit	$ 1,711 11	
Cash on hand and in Banks	180,666 44	
		182,377 55
		$1,387,582 59

Liabilities.

Capital Stock	$1,500,000 00	
Less in Treasury	200,000 00	
		$1,300,000 00
Accounts payable		85 04
Dividend No. 9. Payable 16th June		19,500 00
Profit and Loss		67,997 55
		$1,387,582 59

WORKING ACCOUNT.

Dr.

To Cost of Mining, Development and Prospecting	$ 54,766 04	
" Freight and Treatment	101,336 17	
" Ore Tax	1,052 71	
" Maintenance	1,659 80	
" Depreciation on Ore Sacks	800 00	
" General Expenses	2,054 35	
" Montreal Office Expenses	1,245 86	
" Directors' Fees	2,000 00	
		$164,914 93
" Balance transferred to Profit and Loss		8,701 04
		$173,615 97

Cr.

By Proceeds of Ore Sales	$164,838 72
" Miscellaneous Receipts	8,777 25
	$173,615 97

PROFIT AND LOSS.

Dr.

To Dividends 6 to 9 inclusive	$97,500 00
" Balance	67,997 55
	$165,497 55

Cr.

By Balance at Credit of Profit and Loss	$156,796 51
" " from Working Account	8,701 04
	$165,497 55

DOMINION IRON AND STEEL.

The following is the Directors' report, submitted to the shareholders on the 17th instant:

During the past year the company has steadi y pressed forward with its construction work, aud your directors have to report that, with the exception of the rail mill, the entire plant is now almost completed. As might be expected, the output during the time when the plant was still under construction did not realise working expenses, but your directors anticipate that the expenses will now show reduction each succeeding month, and as soon as the changes on the blast furnaces and other operations mentioned below have been carried out, the company will be able to show satisfactory commercial results.

The principal difficulty to be overcome, in the commencement of an enterprise such as the present is to be able to so contrive from the first that the different parts of the plant will work together harmoniously with the least possible waste of energy and expense; and it is clear that the larger the property is the more difficult it will be to achieve this s atisfactorily. Your directors consider that they have no reason to be discouraged by the course of events in the history of your property. The mistake which has proved the one most detrimental was that of not keeping the washing plant well ahead of the blast furnaces. It was originally calculated that it would be necessary to wash only one-third of the coal required for use in these furnaces, but experience has demonstrated that in order to ensure first-class results, it is necessary that the entire supply should be washed. Since, therefore, the washing plant has now been enlarged, this handicap on the production of the blast furnaces is removed.

As regards the quality of the product, your Directors think that the company has every reason to congratulate itself. The steel manufactured by the company is of the first quality and has everywhere given satisfaction.

During the past year Mr. A. J. Moxham resigned the position of general manager, and Mr. David Baker, superintendent of the works, has been appointed general manager.

The following is a brief description of the property and plant of the company:—

The principal supply of ore is from the company's mine at Bell Island, Newfoundland, about 400 miles from Sydney, where there is an immense deposit of red hematite. This mine has been equipped with modern machinery and shipping piers, capable of handling about 5,000 tons of ore per day. In addition to this mine the company has acquired, for the purpose of obtaining the necessary furnace mixtures, several mining leases in the Province of Nova Scotia, and, for the purpose of making sulphuric acid, a pyrites mine on the coast of Labrador. Some of these properties are now being developed. The company owns a property of remarkably pure marble, from which a very large supply of limestone can be procured. This quarry is situated on the Bras d'Or Lakes, about 60 miles by water from Sydney. There is also a dolomite quarry at George's river, 14 miles by rail from Sydney, from which open hearth furnace lining is obtained, and which was used in the blast furnaces while the Marble Mountain quarry was being developed.

The Marble Mountain quarry is equipped with crushing machinery, and with storage bins and shipping facilities, capable of handling 600 tons per hour. The George's river quarry is also equipped with crushers and shipping appliances of a capacity of 1,200 tons per day.

For receiving the ore and limestone and shipping the product, two piers have been constructed in a most substantial manner; the one, a large pier equipped with five heavy steam unloading machines, rope haulage, and all appliances necessary for the most economical handling of the material; the other, a low level pier, also equipped with four machines, arranged both for unloading ore and loading finished material. From the docks the material is transported in special railway cars about a quarter of a mile to the stock yards, where it is distributed by standard electrically operated ore bridges. The coke for the blast furnace is also brought on railway cars to the bridges from the coke ovens, which are situated about a mile distant.

The coke ovens consist of eight batteries of Otto-Hoffmann by-product ovens, there being 50 ovens in each battery, or 400 in all. The plant, which has been running for some time, has a capacity of 1,200 tons per day, but with the compressing machinery now being installed, it is expected that this will be increased about 10 per cent., and that the quality of the product will be improved, allowing a larger yield from the blast furnaces. The present production of coke averages about 1,000 tons per day. The coke ovens are well equipped with machinery for economically handling material, and are so arranged that the gases usually wasted are collected for heating the open hearth furnaces, and the tar and ammonia saved for sale as by-products.

Before being sent to the ovens, the coal is thoroughly washed, to reduce the ash and sulphur. The washing plant was at first planned to wash only a portion of the coal, but the results were found unsatisfactory, as referred to above, and it has recently been increased to provide for washing all the coal, and is now giving very satisfactory results.

The blast furnaces are four in number, of a capacity of 1,000 tons per day. Since the completion of the washing plant, Nos. 2 and 4 are giving perfect satisfaction. No. 3 will be blown in again on July 10th, after being re-lined, and No. 1 will be blown in shortly after. There is no doubt as to their working satisfactorily. The waste gases from the blast furnaces are used for firing the boilers, supplying steam for the blowing engines, electric plant, and pier unloading machinery.

Open hearth plant: There are ten 50-ton open hearth steel furnaces, of the tilting type. The first heat of steel was made December 30, 1901, and the furnaces have been put in operation as fast as they could be lined up. The fifth furnace was started on the 26th May; the sixth will probably be ready about the 23rd June, and the remaining furnaces at intervals of three and four weeks. The output of steel for the week ending May 31 was 1,800 tons, when four furnaces were in operation, giving a daily average of 75 tons per furnace, but considerable increase of the output per furnace is expected as the organization is perfected.

The open hearth furnaces are contained in a building 102 feet wide by 832 feet long, of steel construction, with the wall spaces filled in with brick. It is equipped with two 75-ton ladle cranes, two Wellman-Seaver charging machines, and has adjacent to it a calcining plant, a ladle repair shop, and gas producers for heating those furnaces not supplied from the coke ovens.

The blooming mill building is 82 feet by 480 feet, of steel and brick construction, similar to the open hearth building. It contains 16 soaking pits, 35 ft. roll train, with latest type of tables; hydraulic and steam shears, steel cranes, billet conveyors, etc. The rolling mill was started in February, and has rolled up to the first of June about 14,000 tons, principally in the shape of billets and slabs.

When the company was first organized it was intended to produce nothing but blooms and billets, but the directors subsequently decided that it would be an advantage to get more capital and provide a modern plant, capable, if necessary, of rolling all the product of the open hearth into finished rail sections The steel frame work for the rail mill, hot bed building, and finishing mill building, is now all erected, and some of the foundations for the machinery are in place. The engines are contracted for, to be delivered August 9th, and much of the machinery is well under way in the company's own shops. Were it necessary, the rail mill could probably be completed in October or November, but in the present condition of the markets it is considered advisable to perfect the organization of the other departments before pushing the rail mill to completion.

The rail mill building is 530 ft. x 65 ft., with engine houses alongside; the hot bed building, 90 ft. x 135 ft., and the finishing mill building, 90 ft. x 525 feet. They are all of heavy steel construction; to be covered on the sides with expanded metal and cement, and to have corrugated iron roofs. All of the equipment will be of the latest type to handle the product in the most economical manner.

In addition to the steel making plant proper, the company has a foundry, 92 ft. x 192 ft., equipped with two electric travelling cranes, and cupolas for making iron and brass castings. A machine shop, 92 ft. x 256 ft., which has a full equipment of machine tools capable of handling all the repair work, and in which a large part of the new rail mill is now being constructed. There are also a large wood-working shop, tin shop, and pipe shop, all well organized and equipped to make repairs or construct anything required about the plant.

There is an electric power station, equipped with three 300 k.w. generators, to supply current for lighting, electric cranes, and other electrically driven machinery about the plant. It is built in a most substantial manner, with a steel frame, brick walls, and tiled roof. All machinery in it is the best procurable.

The docks and various departments are connected by a complete system of broad gauge tracks, about 15½ miles in all, and the steel departments have in addition a system of narrow guage tracks covering 2½ miles.

The rolling stock comprises 81 flat cars, 59 gondolas, 90 hoppers, two 80-ton locomotives, three 50-ton locomotives, two 45-ton locomotives, and one 53-ton locomotive, all of standard gauge and a full equipment of narrow gauge locomotives and cars, consisting of five locomotives, 54 ingot cars, 38 billet cars. and 40 charging boxes.

The company controls an unlimited fresh water supply from Sydney River, about five miles distant, to which connection has been made by a 24 in. main, and where a pumping station has been erected, with pumps of about 6,000,000 gallons daily capacity.

The company owns about 500 acres of land, deeded to it by the Corporation of Sydney, for the purposes of its works and possible additions to the plant, and has also acquired other real estate, affording ample space for workmen's houses; a number of these have been erected, suitable for the company's employes.

Respectfully submitted,

ROBERT MACKAY,
Acting President.

DOMINION IRON & STEEL COMPANY, LIMITED.

Balance Sheet as of April 30th, 1902.

ASSETS.

Propert Account	$29,419,534 62	
Cash	97,983 20	
Accounts Receivable	591,198 43	
Product on hand	590,793 62	
Raw Material on hand	600,983 65	
Warehouse Material on hand	296,894 53	
		$31,597,388 05

LIABILITIES.

Bonds	$8,000,000 00	
Common Stock	15,000,000 00	
Preferred Stock	5,000,000 00	
Notes Payable	2,589,550 54	
Accounts Payable	955,396 14	
Reserve for replacement	52,441 37	
		$31,597,388 05

N.B.—Since the close of this report 50,000 shares common stock have been underwritten at $60.00 per share. This will bring the sum of $3,000,000 (less commission) into the treasury by July 11th, and will be used for reducing the debt and further improving the property.

R.M.

Rossland Great Western.—The company's manager at Rossland cables:—"Downward continuance of high-grade ore shoot below the 300 feet level has been disordered by dyke and faults."

NEW COMPANIES.

BRITISH COLUMBIA.

Diamond Vale Coal and Iron Mines, Ltd.—Incorporated 12th May, 1902. Authorized Capital, $1,000,000, in shares of $1.00 each.

Brydges, Blakemore & Cameron, Ltd.—Incorporated June 9th, 1902. Authorized Capital, $50,000, in shares of $1.00 each.

Commodore Mines, Ltd.—Incorporated 20th June, 1902. Authorized Capital, $750,000, divided into 75,000 shares of $10.00 each.

Juno Mines, Ltd.—Re-incorporated 27th June, 1902. Authorized Capital, $625,000, divided into 2,500.000 shares of 25 cts. each.

International Gold Mining and Development Co., Ltd.—Incorporated 3rd July, 1902. Authorized Capital, $1,000,000, in shares of $1.00 each.

NEW BRUNSWICK.

British Columbia Mica Co., Ltd.—Authorized Capital, $1,000,000, in shares of $100 00 each. Head office: Lewisville, New Brunswick.

ONTARIO.

The Flint Lake Gold Company, Ltd.—Incorporated 25th June. 1902. Authorized Capital, $100,000.

The Mariposa Mining Co., Ltd.—Incorporated July 16th, 1902. Authorized Capital, $3,000,000, in 600,000 shares of $5.00 each. Head office: Sault Ste. Marie, Ont.

The Phœnix Gold Mining Co., Ltd.—Incorporated 13th June, 1902. Authorized Capital, $1,000,000, in shares of $1.00. Head Office: Fort Erie, Ont.

The Dunwich Gas and Oil Co., Ltd.—Incorporated 25th June, 1902. Authorized Capital, $100,000, divided into 400,000 shares of 25 cents each. Head office: St. Thomas, Ont.

The Clover Leaf Mining Co, Ltd.—Incorporated 20th June, 1902. Authorized Capital, $1,000,000, in shares of $1.00 each. Head office: Toronto, Ont.

The Copper Queen Mining Co., Ltd.—Incorporated 27th May, 1902. Authorized Capital, $3,000,000, divided into 300,000 shares of $10.00 each. Heod office: Sault Ste. Marie, Ont.

Oil Exploration of Canada, Ltd.—Incorporated 27th May, 1902. Authorized Capital, $200,000, in shares of $100.00 each. Head office: Walkerville, Ont.

Union Petroleum Co. of Canada, Ltd.—Incorporated 31st May, 1902. Authorized Capital, $25,000, in shares of $100.00 each Head office: Toronto, Ont.

The Syndicate No. 1, Ltd.—Incorporated 27th May, 1902. Authorized Capital, $5,000 Head office: Rat Portage, Ont

Protogene Gold Mines Company, Ltd—Incorporated 31st May, 1902 Authorized Capital, $1,500,000; shares $1.00 each. Head office: Windsor, Ont.

Giant Gold Company, Ltd—Incorporated 31st May, 1902. Authorized Capital, $700,000, in shares of $1.00 each. Head office, Gold Rock, Ont.

Monitor and Ajax Fraction Ltd.—The following cablegram was received from the manager, dated Three Forks, 11th inst.:—"Struck important body of ore three feet wide, level No. 5. The ledge is believed to run for a distance of about 5.000 feet through our properties; it has already been proved in levels 3 and 4 to a distance of about 1,200 feet. starting from the point at which the No. 5 cross-cut tunnel has struck it. The vast importance of this strike needs no comment, as between those who know the ground and understand this class of mining The big strike in No. 5 seems, allowing for the dip of the ledge to be under a very important 'chute,' which was driven through in No 4, where the pay streak was found to be from 18 inches to 2 feet wide Present appearances indicate that this chute extends the entire distance between the two levels, viz: 217 feet."

MICA PROPERTIES FOR SALE.

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The Crystal Gold Mine for Sale.

The undersigned offers for sale Mining Location W.D. 43 in the Township of Rathbun. A large amount of development has been done upon this property. A ten-stamp mill has been erected, with five stamps working. Bullion to the value of $7,500 has been produced, on an average of $12.00 per ton. The ore is free milling. Tenders for above property will be received by the undersigned, from whom full particulars can be obtained.

WM. R. WHITE,
Liquidator of The Crystal Gold Mining Co. of Rathbun, Limited.

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CANADIAN MINING INSTITUTE.

BRITISH COLUMBIA SECTION.

A PUBLIC MEETING of Mine Owners, Mine Managers, Mining Engineers, Assayers, and all who may be interested in promoting the welfare of the profession and industry of mining in British Columbia, will be held in the **CITY OF NELSON,** on

Tuesday, 9th September, 1902

(AFTERNOON AND EVENING SESSIONS)

for the purpose of completing the British Columbia Section of the Institutel
A programme of papers of interest to mining men in the Province wil. be submitted for discussion.

B. T. A. BELL, *General Secretary.* CHARLES FERGIE, *President.* R. R. HEDLEY, *Chairman.*

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The Canadian Mining Manual

FOR 1902

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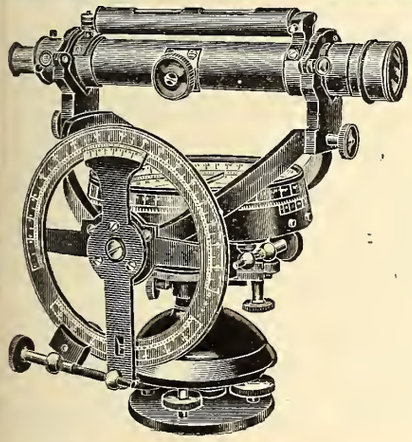
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   - (*d*) Chemical Engineering.

   GROUP II.
   - (*e*) Civil Engineering.
   - (*f*) Mechanical Engineering.
   - (*g*) Electrical Engineering.

   GROUP III.
   - (*h*) Biology and Public Health.
3. COURSES IN CHEMISTRY, MINERALOGY AND GEOLOGY for degrees of Bachelor of Arts (B.A.) and Master of Arts (M.A.

For further information see the Calendar of Queen's University.

4. POST-GRADUATE COURSE FOR THE DEGREE OF Doctor of Science (D.Sc.)

For further information see the Calendar of Queen's University.

Next Session begins October 1st, 1902.

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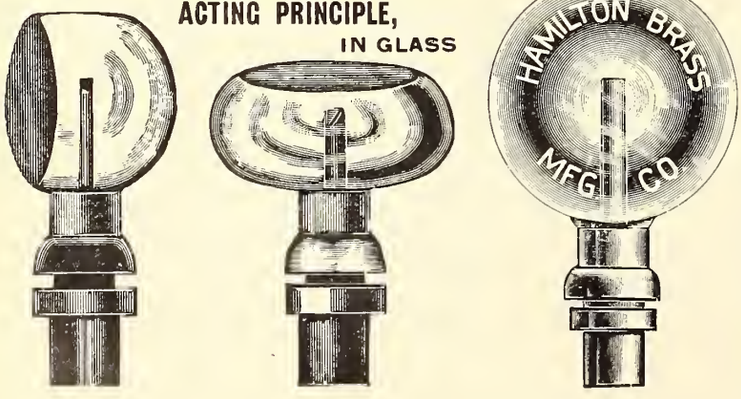
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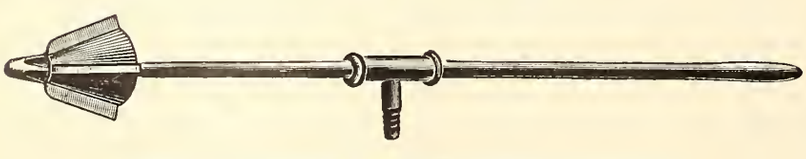
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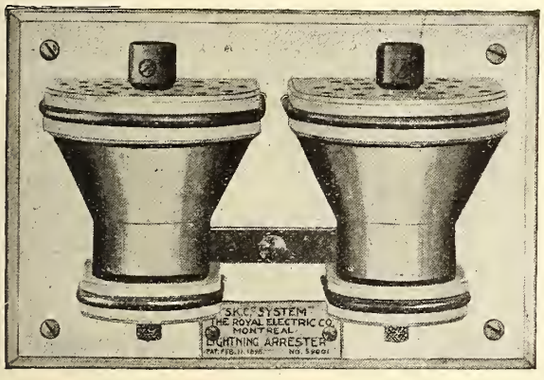
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GOLD AND SILVER.

Under the provisions of Chap. 1. Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
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The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental – such royalties unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at the mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order in Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's Certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end on the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 an acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee $5.00 renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed in the river below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent. on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River and Hill Claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer Claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim, and each person in his or its employment, except house servants, must hold a Free Miner's Certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of five per cent charged on the gross output of the claim, with the exception of an annual exemption of $5,000.00.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek or gulch, but the same miner may hold any number of claims by purchase, and Free Miners, not exceeding ten in number, may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch or river, by giving notice and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00 and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette.*

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, and a royalty of five per cent. on the gross output, less an annual exemption of $25,000.00 are charged. Operations must be commenced within one year from the date of the lease, and not less than $5,000 must be expended annually. The lease excludes all base metals, quartz and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite: copper in sulphide and native form; gold, mostly in free milling quartz; silver, native and sulphides; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc, apply to

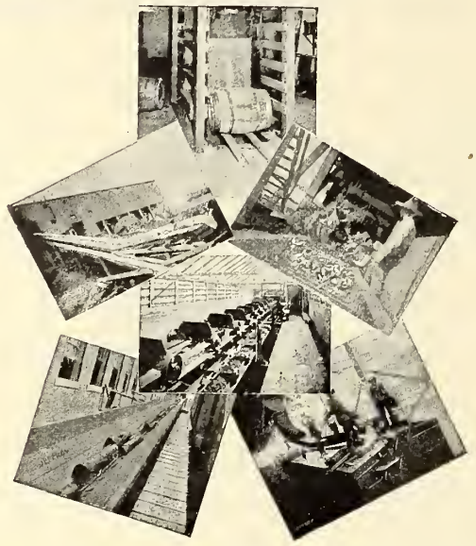
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Commissioner of Crown Lands,

or

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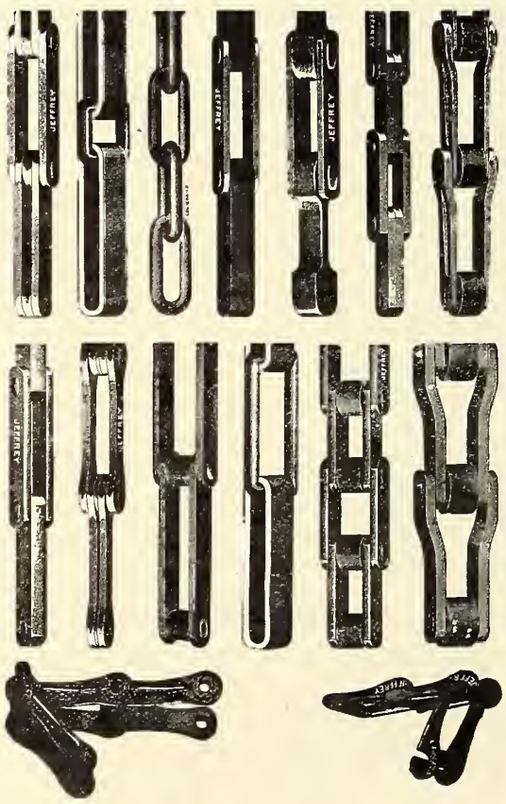


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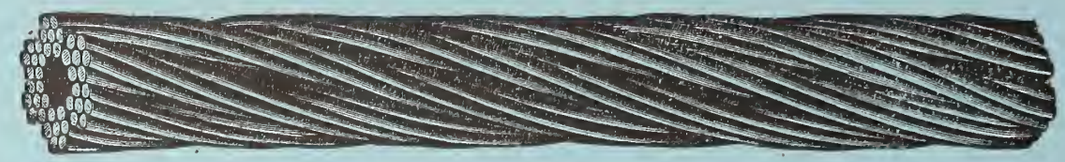
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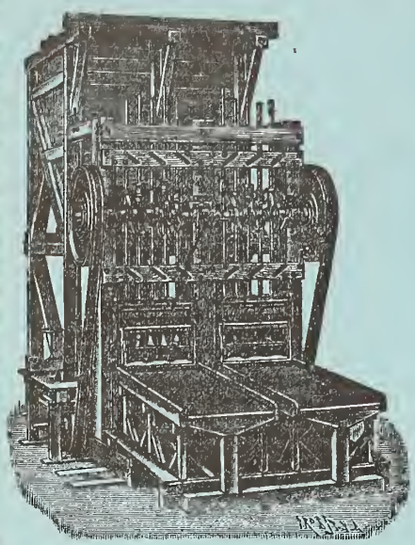
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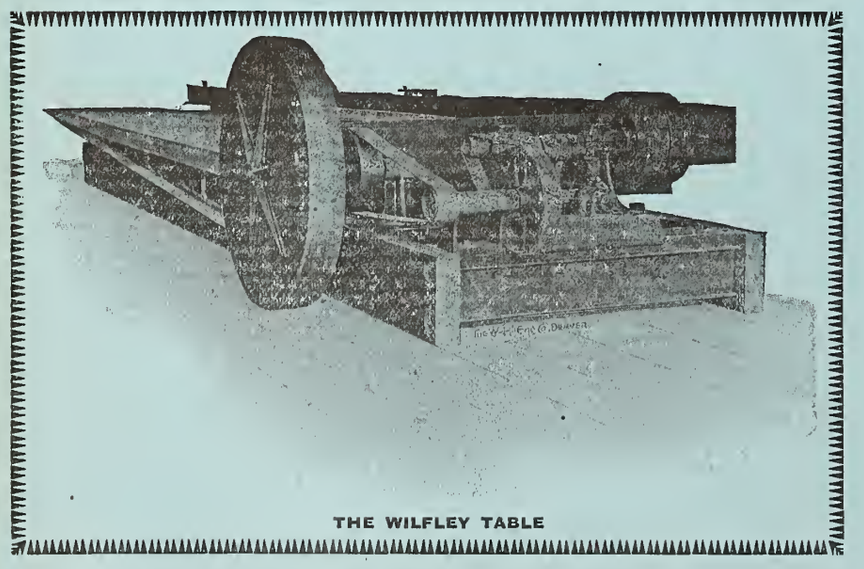
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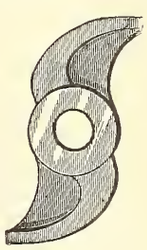
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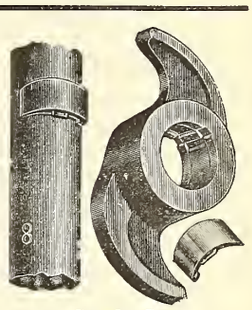


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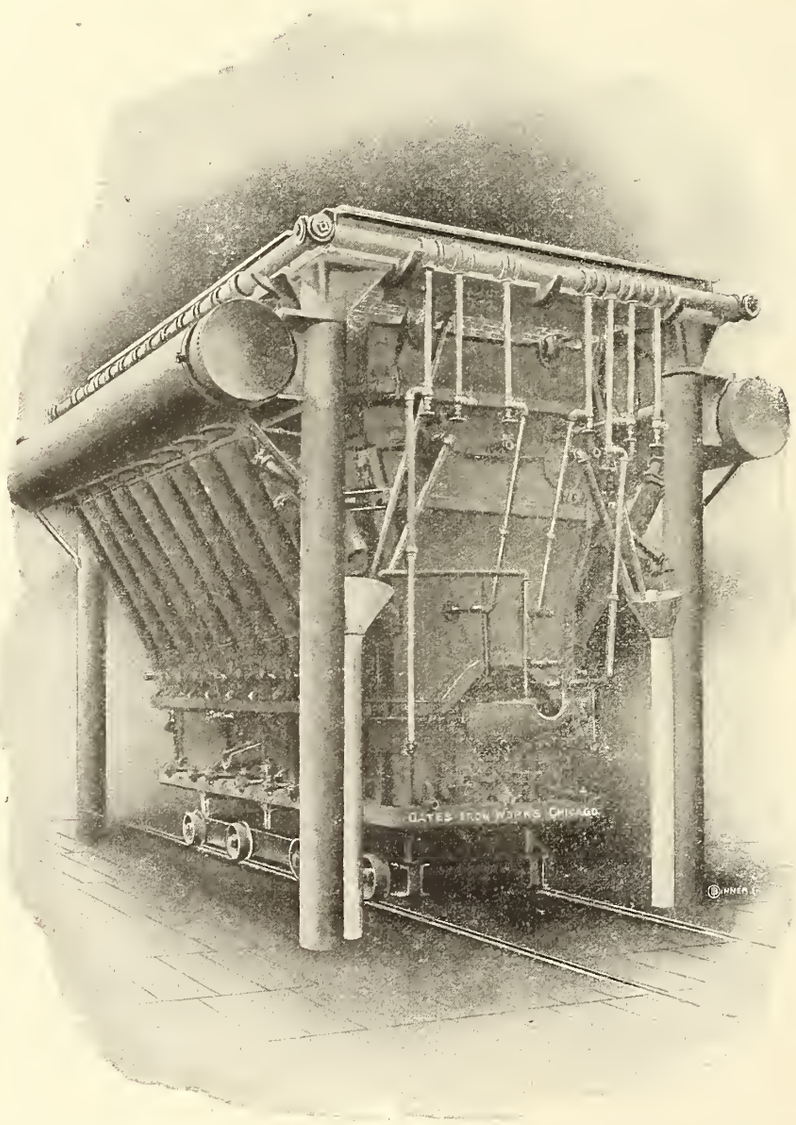
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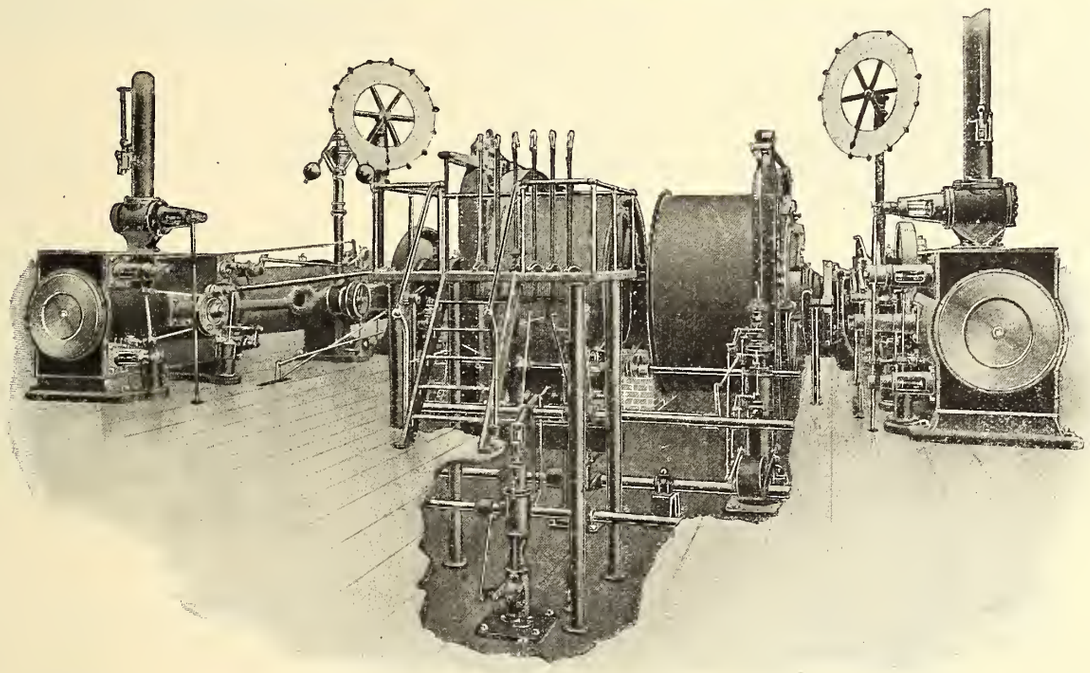
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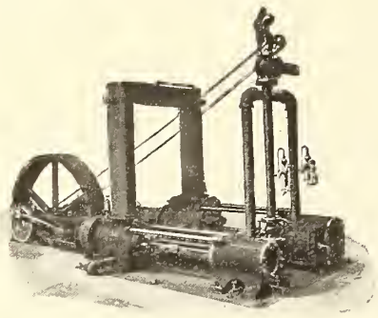
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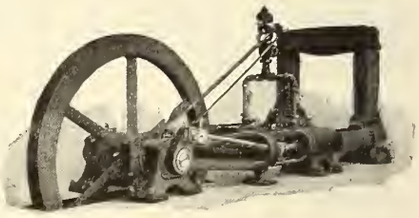
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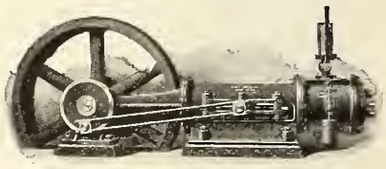
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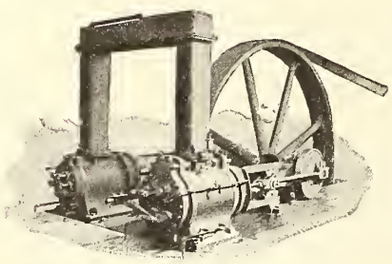
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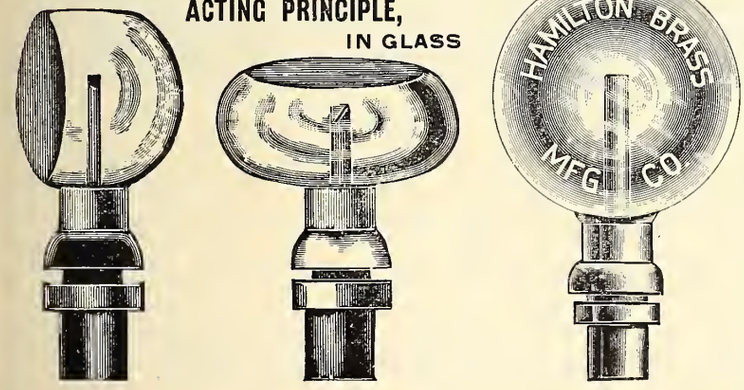
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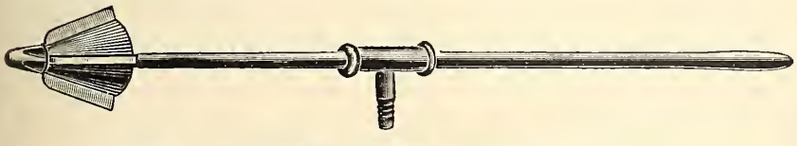
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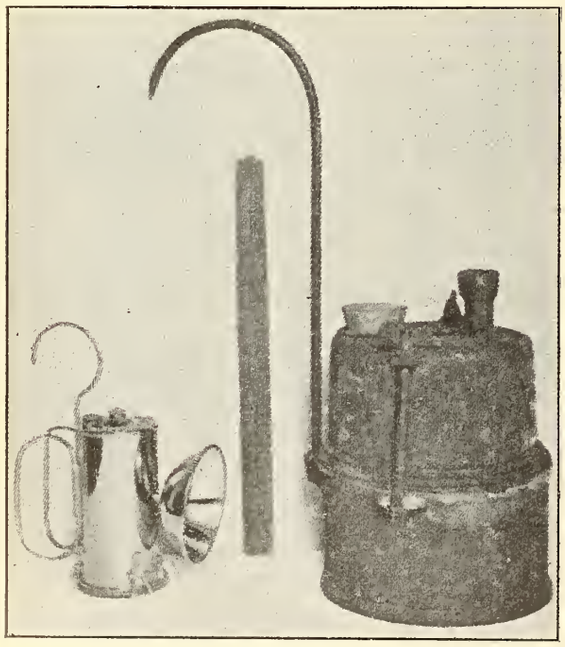
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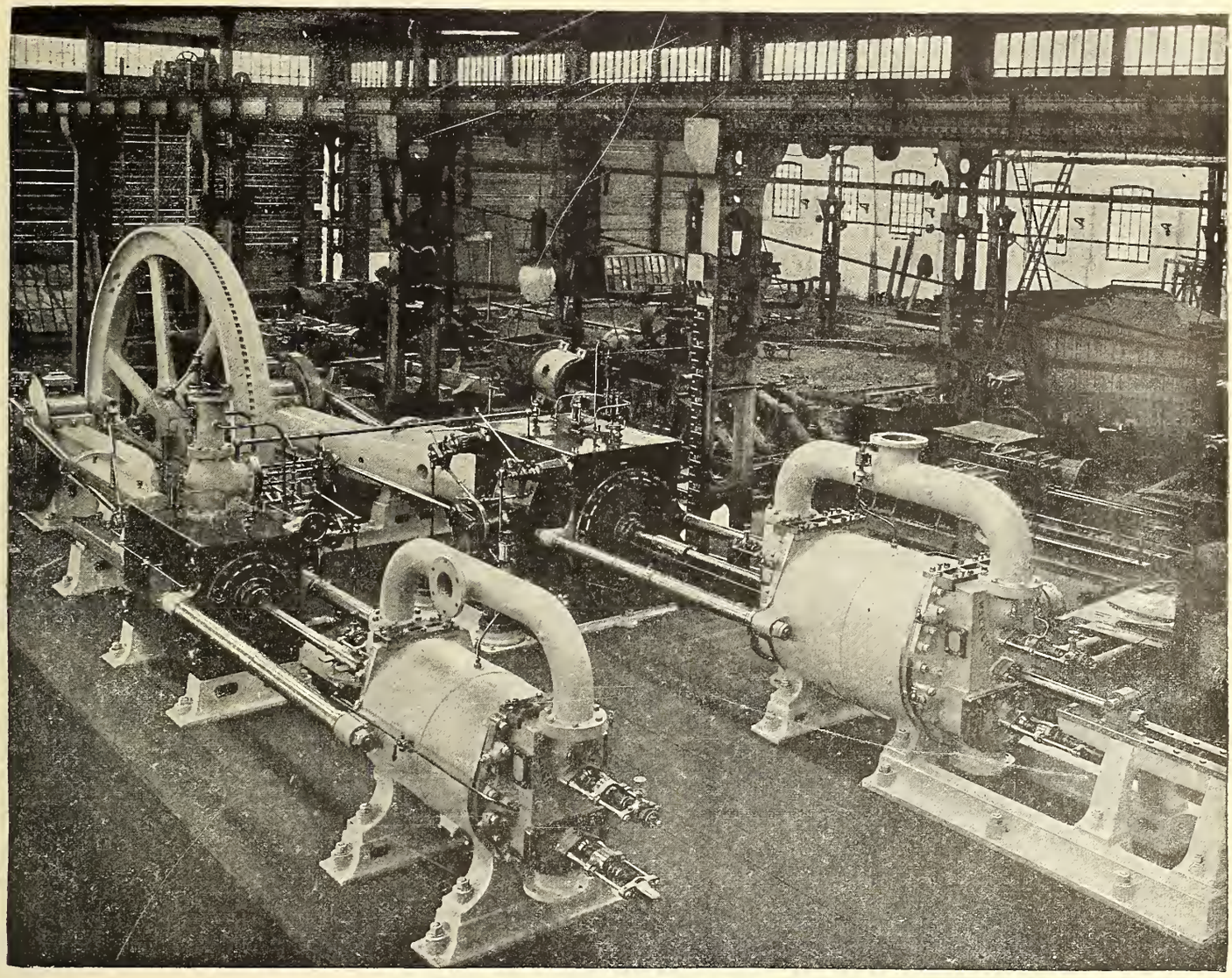
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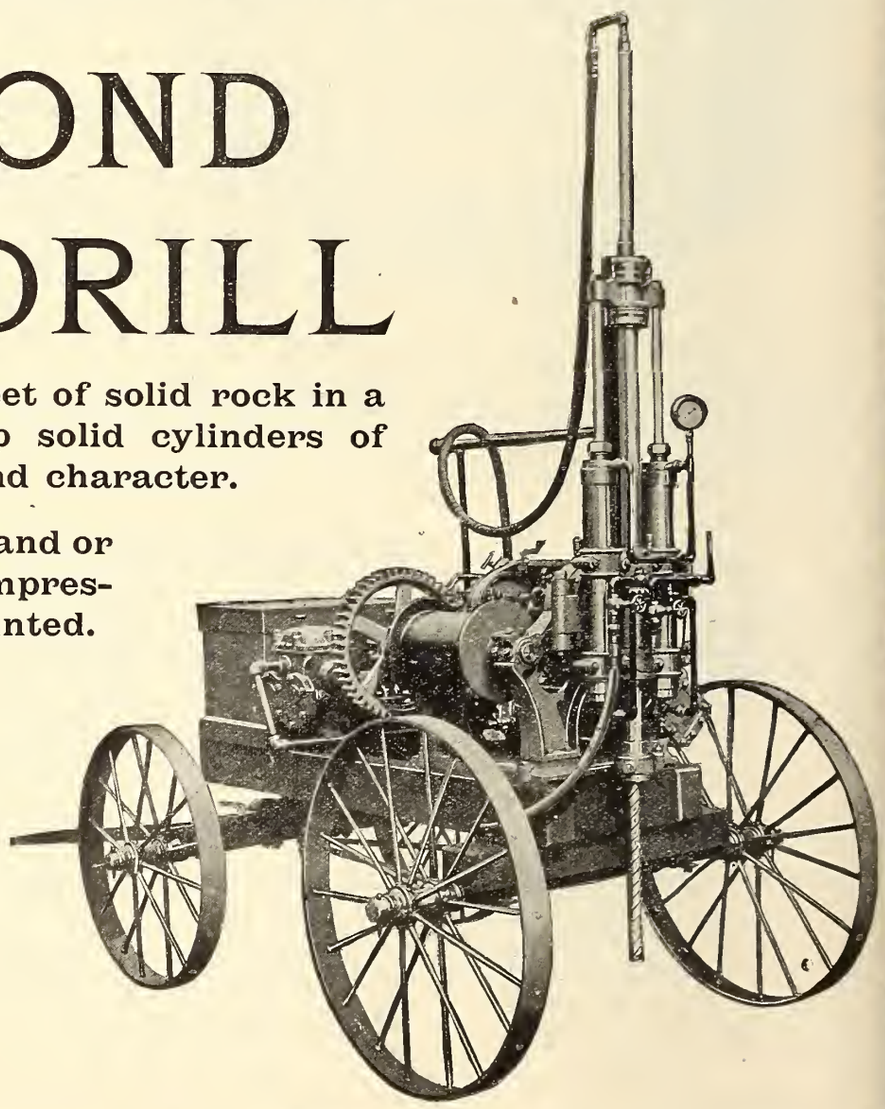
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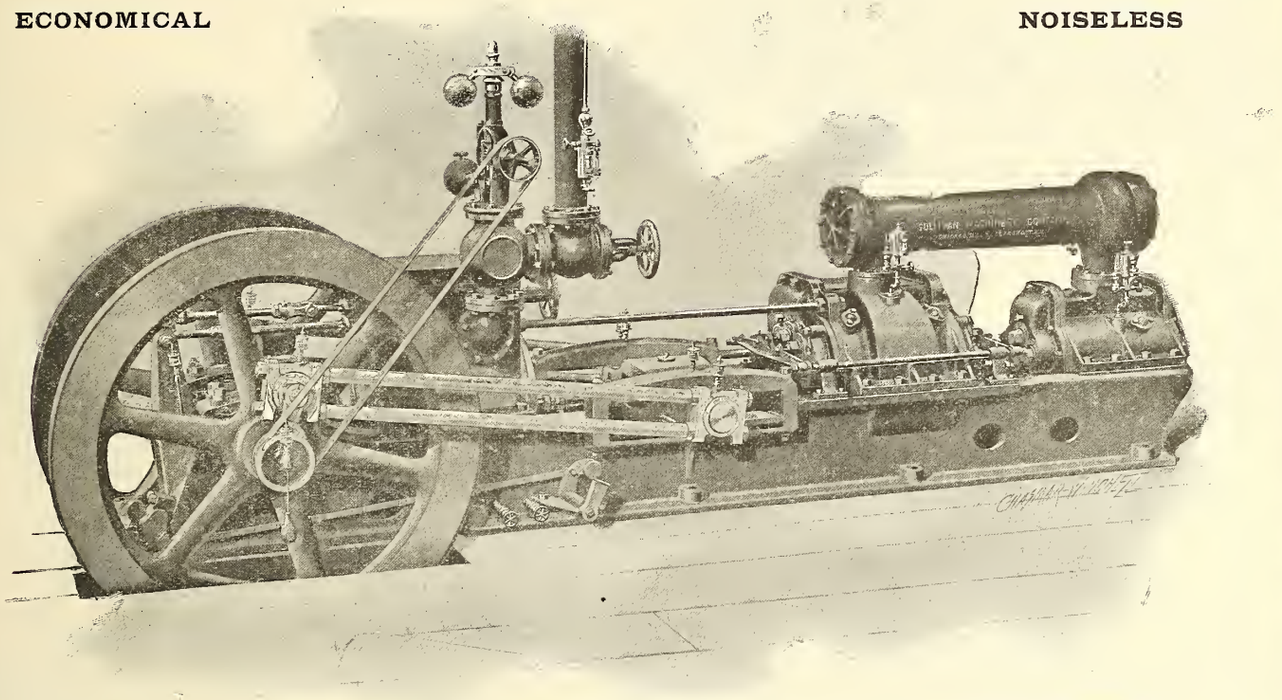
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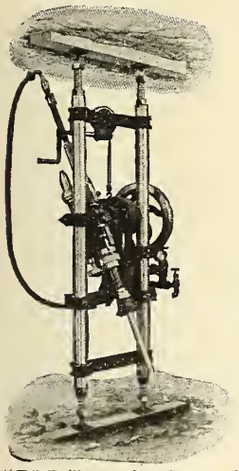
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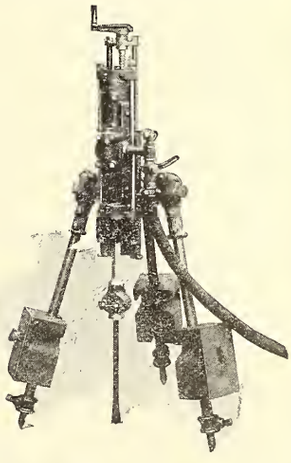


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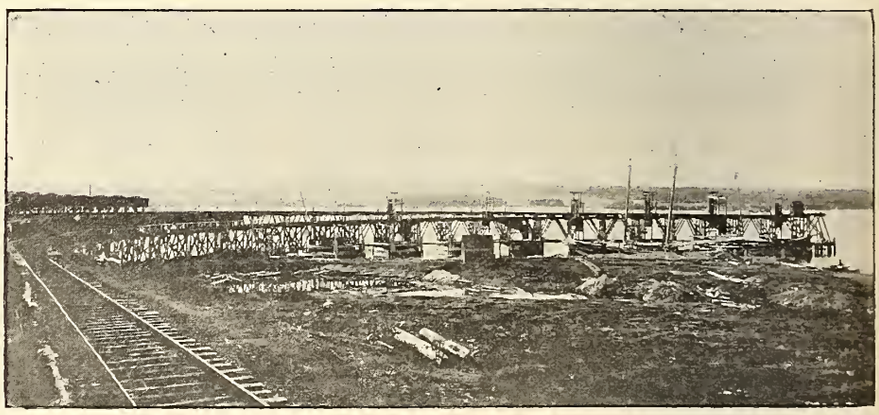
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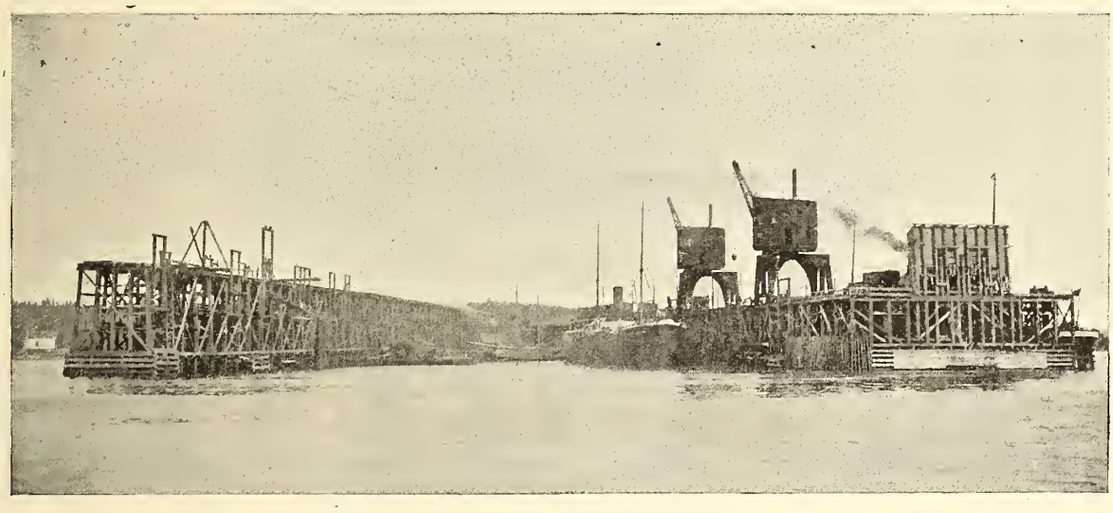
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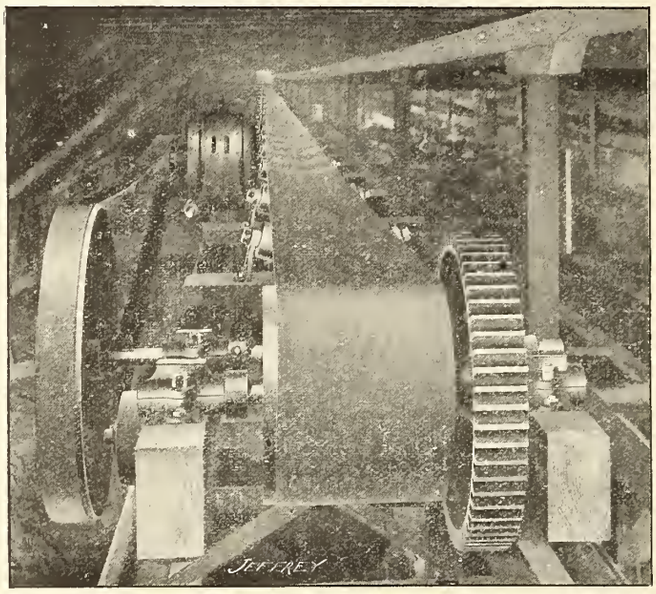
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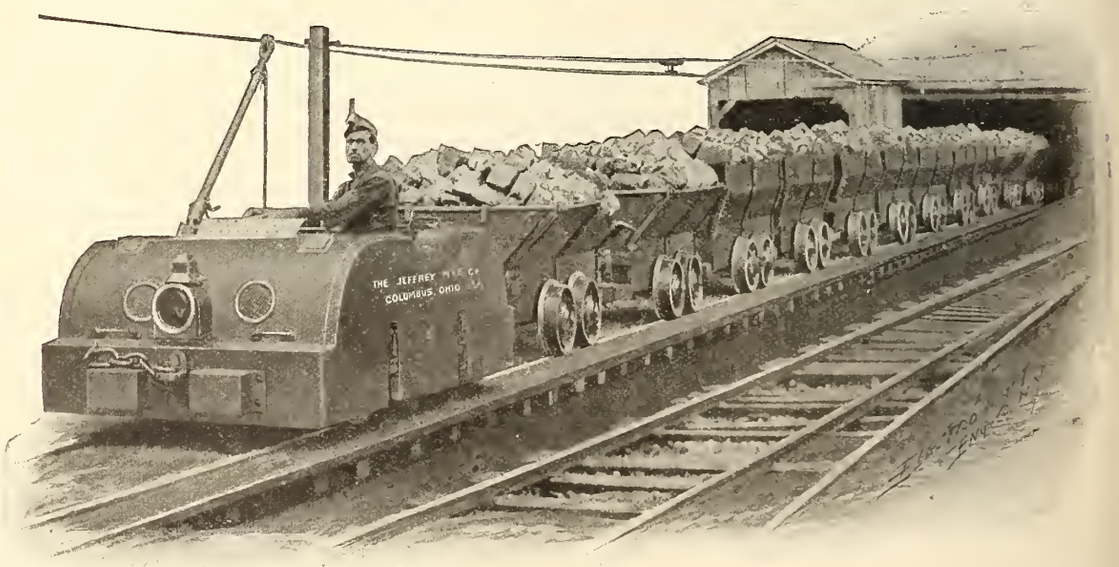
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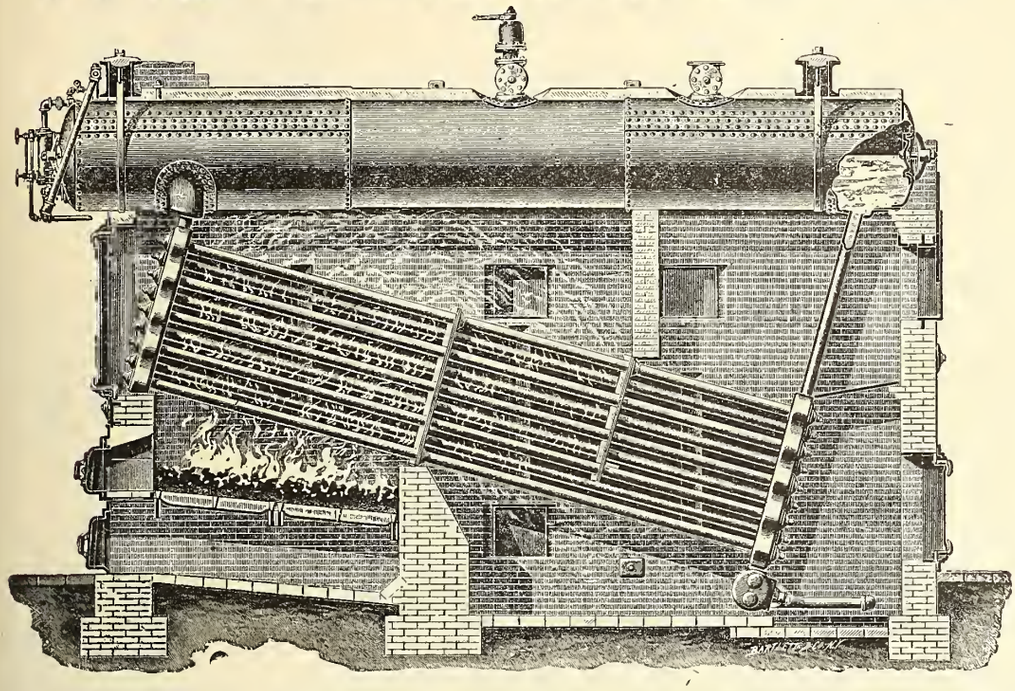
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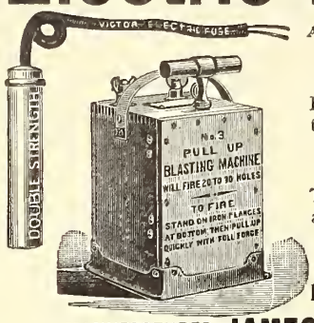
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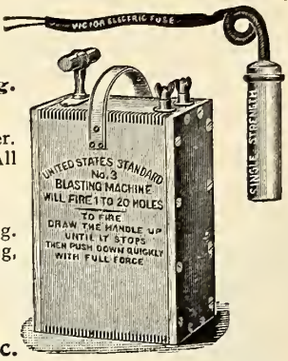
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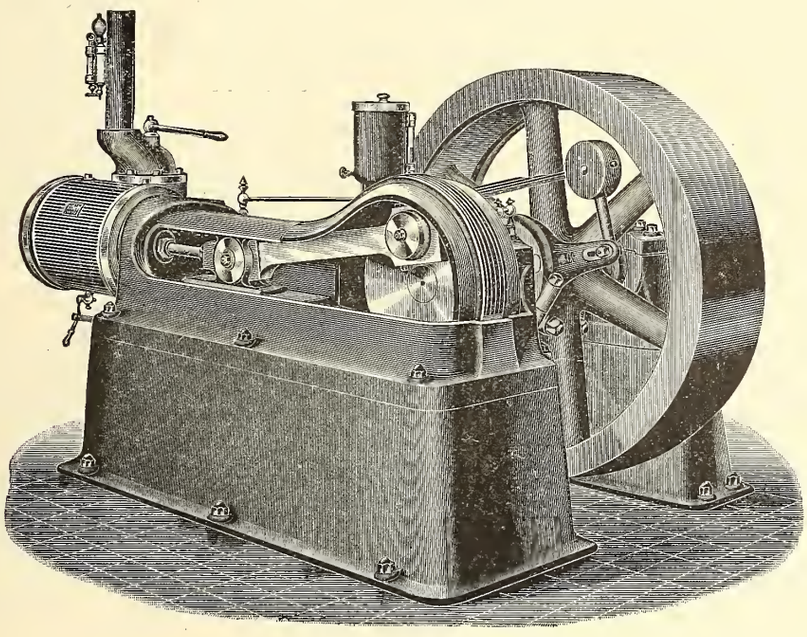
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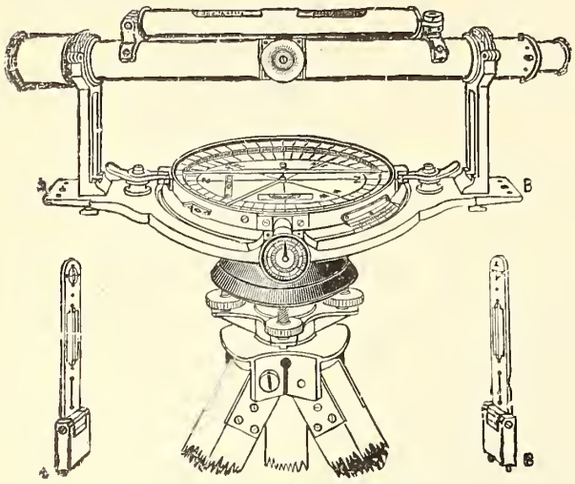
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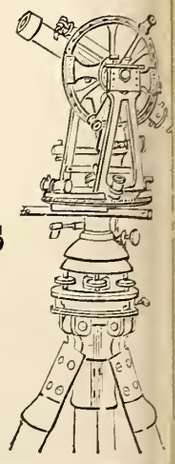
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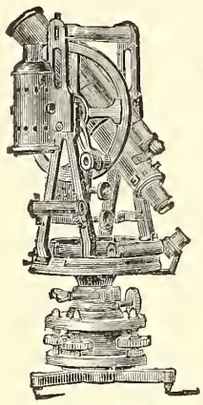
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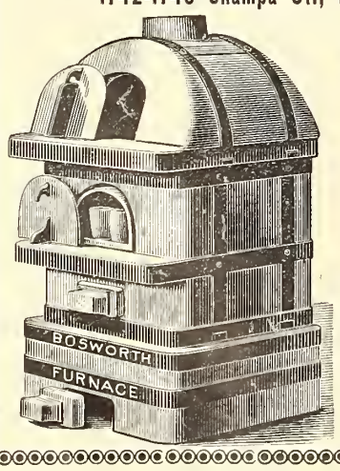
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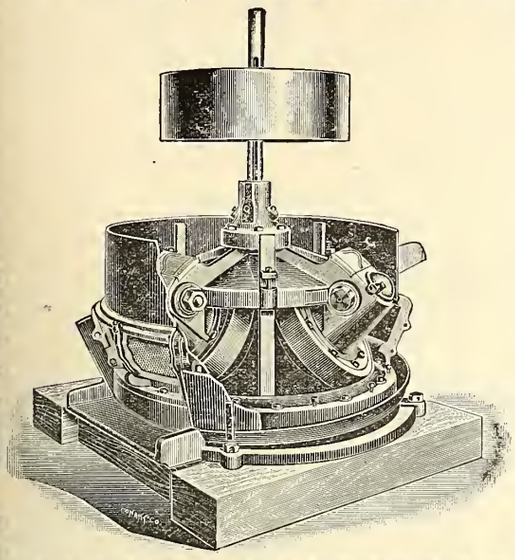
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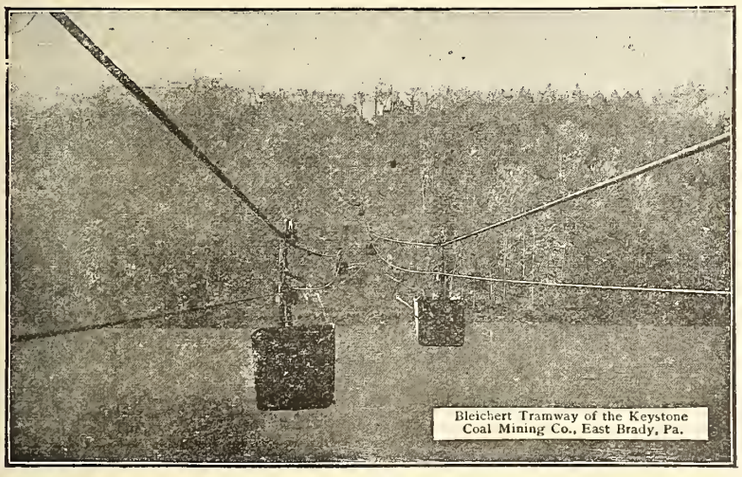
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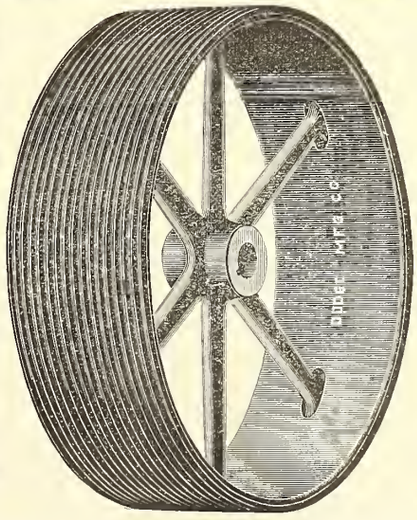
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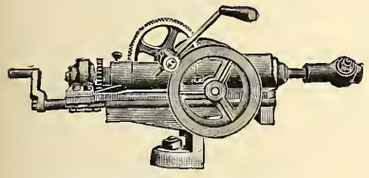
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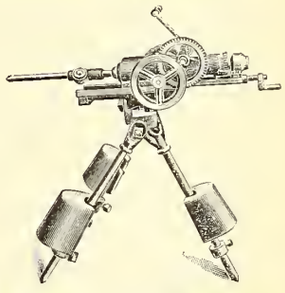
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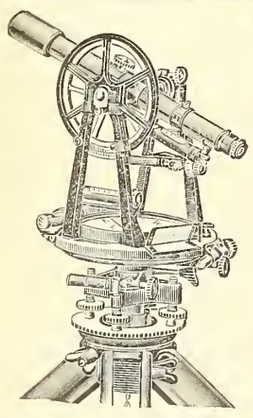
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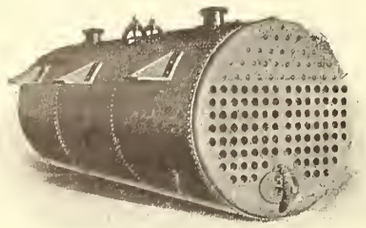
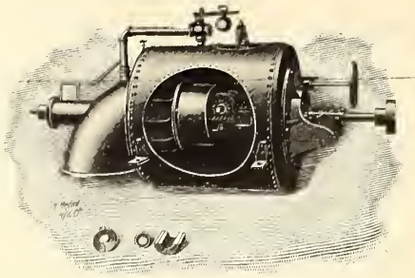
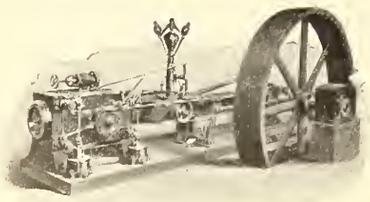
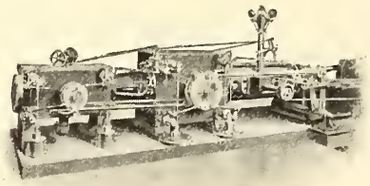
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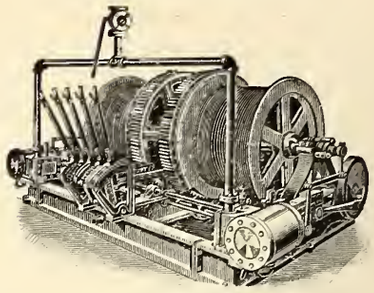
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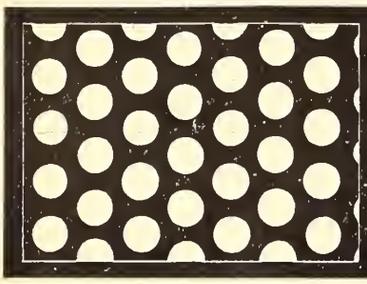
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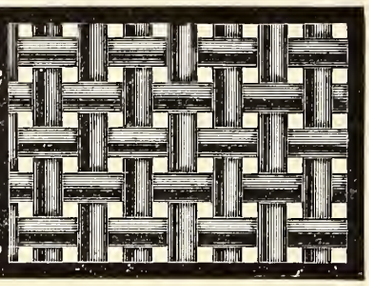
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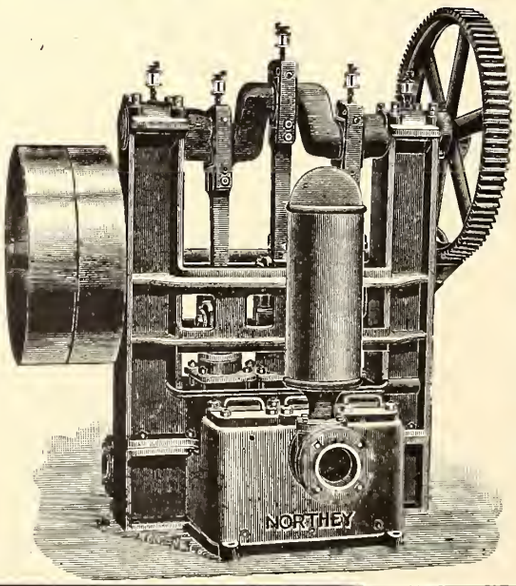
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VOL. XXI., No. 8. AUGUST, 1902. VOL. XXI., No. 8.

Mining Progress in Nova Scotia.

The present summer shows the continued prosperity of Nova Scotia mines. Work has continued steadily, and good prices have been realised for the coal, one of the best customers of the trade being the Dominion Iron and Steel Company, which took last quarter about 150,000 tons. The Dominion Coal Company has successfully sunk its big No. 2 shafts, and the bankhead, one of the largest in the world, is being pushed rapidly. The underground workings are being extended, and an output of 2,000 tons a day is maintained by temporary hoisting engines. The Nova Scotia Steel and Coal Company is completing a new Donkin shipping pier at North Sydney, and is opening a slope on the Lloyds Cove seam, and preparing to develop the Boularderie section.

The Cape Breton, New Campbelton, and Port Morien mines are working steadily. On the northern side of the island, the Inverness and Richmond Collieries and Railway Co. are continuing their development at Broad Cove, and building a shipping pier at Port Hastings on the Strait of Canso.

The Port Hood Colliery is now in steady working order, and taking its share of the trade. At Mabou a company is preparing to develop the submarine areas, and to build a railroad from the mine to Orangedale on the Intercolonial Railway.

Extensive explorations are being carried on in every part of Cape Breton suspected to contain coal. The Mullin's seam has been traced for a couple of miles from the head of Lingan Bay towards Sydney, and outcrops of new seams are reported from the Cow Bay district.

In the River Inhabitants Basin the outcrops of some coal beds have been traced, but as yet no systematic exploration work is being done.

On the Mainland, work has continued in the coal mines with few changes of interest. The Marsh Colliery, near New Glasgow, of the Nova Scotia Steel and Coal Company, has become a regular producer of coal. The output of this mine is entirely absorbed by the company's steel works. The total production of the quarter ended June 30th is about 60,000 tons greater than that of the corresponding quarter last year when the production amounted to 1,040,000 tons.

The five Government drills have been kept in steady work proving underlying seams at certain collieries, and testing the coal producing limits. Borings made in Hants and Colchester counties, while not penetrating seams large enough to be of economic valne, have served to define more accurately the productive areas.

The interest of geologists, miners, and of the general public has long been turned on the problem of the existence of coal field north of New Glasgow. Here a series of rocks newer than the coal measures occur throughout the northern part of Pictou County, out under the Gulf and Prince Edward Island. If, as there is reason to believe, the coal of New Glasgow, interrupted by a bed of conglomerate, extends under these newer rocks, there are hundreds of square miles of coal fields. The Government of Nova Scotia, acting in conjunction with some energetic parties in Pictou County, has purchased a Calyx drill capable of boring to a depth of 3,000 feet. It is proposed to bore to the north of New Glasgow in the hope that before this depth is reached, the presence of a coal field may be proved. If this experiment proves successful, Pictou may be a great coal-producing centre when many more pretentious districts have been abandoned.

The Dominion Iron and Steel Company may now be said to have overcome the difficulties experienced in getting their blast furnaces in good working order. Their coke is now of a grade equal to the burden. Some of the converters are now working, and the remainder will shortly be completed. The frame of the steel rail mill is up, and it should be running at the end of the year. When completed, these works will require over 800,000 tons of coal a year. The Dominion Iron and Steel Company, possibly in anticipation of an export duty on iron ore leaving Newfoundland, are turning some attention to provincial iron ore deposits. Some prospecting has been done at Mira, Whycogomah, and other points. The presence of the cheap and good Newfoundland ore has discouraged search for local ores.

The Nova Scotia Steel and Coal Company are gradually getting their steel plant under way. It is confidently expected hat Mr. Graham Fraser, with his great local experience, will present his shareholders with a plant up-to-date in every respect, and not burdened with the expenses of experiences dearly bought by an amateur. The Torbrook iron ore district in Annapolis County has been fully proved to be of enormous extent, and will play an important part in the next iron ore deal in Nova Scotia.

The gold industry has kept on its usual quiet way, the returns for the past quarter being about 6,500 ounces. The mines working last year have, with few exceptions, continued at a profit. The Dolliver Mountain Company is now getting its preliminary work pushed, and should soon be added to the list of our larger producers. The Richardson, Waverley, Brookfield, Royal Oak and Blue Nose mines may be named among those working steadily. Few new discoveries of value have been reported. The prospector of the early days of gold mining in this province has nearly disappeared, and his loss is being felt, as the number of men who devoted themselves to prospecting is steadily

decreasing. Their skill and patience in detecting and following the traces of veins laid the foundation of all our best mines.

Another cause of the quietness in gold mining may be found in the fact that investors now demand properties prepared for inspection and with considerable development work on them. This necessitates the expenditure of time and money, two requisites not always combined in the Nova Scotia promotor.

The manganese ores of the College Grant, Lunenburg Co., are being systematically examined on behalf of some New York parties, but the production of the other deposits is practically *nil*. The gypsum, quarry, oil shale, infusional earth, and the brick-making interests are kept employed as usual.

A Nova Scotia School of Mines.

The desire of the supporters of Dalhousie College to add a School of Mines to their prosperous University naturally leads to the consideration of the instruction proposed.

At present one branch of mining education has received considerable successful attention from the Government of Nova Scotia. There are seven coal mining districts, and for them about twelve local instructors have been appointed. These men conduct classes, and present to a Provincial Board candidates for certificates as Underground Managers and Overmen. The managers of the coal mines are also required to pass before the Board, but as yet it has been found impossible to provide more than a partial instruction to enable them to qualify themselves

The principle underlying the qualifications of these men is that they be at least twenty-one years of age, be of good character, and have been employed underground for at least four years, and that their practical underground experience should be added to by a knowledge of the principles of ventilation, working, surveying, etc., to meet the general requirements of coal mining. Similar arrangements have been made with respect to enginemen employed in raising and lowering men in coal mines.

The Government recognising that the holders of these certificates had to be drawn from men unable to spare the time to attend Collegiate lectures, sent instructors to them, and has succeeded in passing numerous candidates on a grade at least equal to that demanded by other Governments.

Under this system over five hundred and fifty certificates have been issued, and a number of our mines are being successfully managed by men who began work in them in the most humble capacities.

The Province having made this provision for its coal mine officials might logically be called upon to consider the advisability of instructing the gold and iron and other mine managers and foremen, and further of providing in the general interest of the mineral resources of the Province for the education of trained mining geologists, mineralogists and experts. The scattered positions of these mines rendered the extension of the educational system as applied to the coal mines, of doubtful value, and the undertaking of a fully equipped School of Mines appeared in view of the pressing demands from other important industrial occupations to be a matter requiring careful consideration. It is at this state of the evolution of mining education in Nova Scotia that Dalhousie College proposes to enter the field. If it equips a School of Mines on the lines laid down by McGill and Queen's Universities, it fulfils the last logical step which could be demanded from the Government of Nova Scotia.

It will doubtless from its three or four years course turn out men well equipped in the theory of mining, and instructed in the sciences underlying its application, but devoid of practical experience. On the other hand the Mines Department is giving to men more or less qualified practically some general knowledge of the laws and theory underlying the management of coal mines. In order to avoid waste of money and energy these two schemes should be modified to supply their deficiencies.

It may be conceded that in the comparatively extensive communities engaged in coal mining, the present system of the Government is is the best for underground officials and enginemen, many of whom are obliged to labor for their living, and could not afford to attend regular courses. In the case of other mines it might be possible by a system of district scholarships to enable promising men to receive instruction at some School of Mines. In the case of those desiring certificates as Managers of coal mines, having passed the lower grades, it might be feasible by a similar system of scholarships to assist annually a certain number of those obtaining the highest marks as Underground Managers to qualify themselves in a School of Mines for that final grade.

As practical experience in underground employment is justly considered essential in candidates for the mining certificates of the Department of Mines, the graduates of a School of Mines would be obliged to add a term of underground employment before receiving an equivalent of a certificate of competency.

As the object of the Government of the Province, and of the Governors of Dalhousie is in this connection primarily the development and proper working of our mines, it is to be hoped that upon the establishment of the School of Mines, both parties will agree upon a course of studies and regulation of time which will combine the practical and academic sides of mining education.

Mining Progress in British Columbia.

The annual report of the Minister of Mines for the year 1901 was issued this month, and, as in former years, contains an immense amount of serviceable information concerning the mines and mining districts of British Columbia.

The volume is beautifully printed and handsomely illustrated, and Mr. Robertson, the Provincial Mineralogist, is to be congratulated upon its publication.

In the opening section of the volume, Mr. Robertson reviews the progress of the various mining industries as follows:—The mining industry has, during 1901, still maintained that rapid growth which has characterised it since the inception of lode mining some ten years ago. It is all the more gratifying to be able to make this announcement again this year, inasmuch as reports to the contrary have been so widely circulated that the impression that 1901 has proved a disastrous year has gained much credence, not only abroad, but even within our own borders. Statistics are the best refutation of this impression, and it is with much gratification that attention is drawn to the preceding statistical tables. These show that the value of the mineral production of this Province for the past year is greater than that of the Yukon ; that we have in our mineral deposits a "Klondike" of our own, and a permanent and growing one at that. The Yukon is credited with an output of $18,000,000, while British Columbia produced $20,086,780.

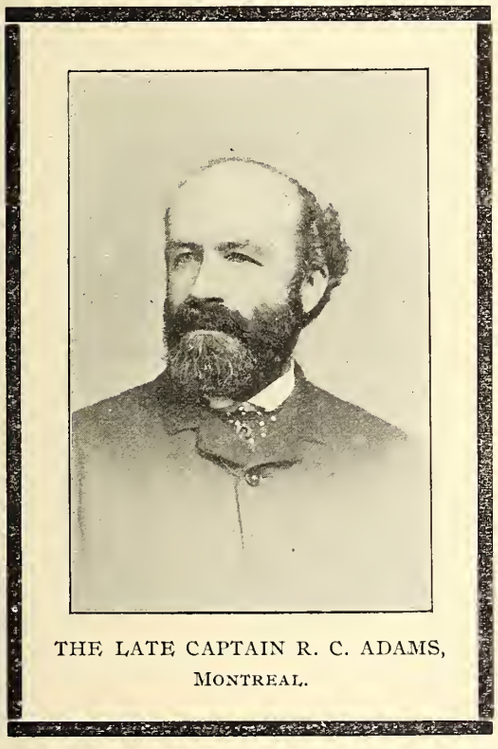
Table 1 gives the total values of the various mineral products of the Province up to and including the year 1901, showing the amount contributed by each mineral to make up the total of $172,241,988, the grand total of the Province's earned increment to the mineral wealth of the world. Gold still retains the first place in this list with a total production of $63,554,543, coal and coke following with a total production of $54,157,315.

OBITUARY.

The Late Captain Robert C. Adams, Montreal, and Howard West, A. R. S. M., New Denver, B.C.

The Review sorrowfully chronicles this month the loss of two well known members of the profession and industry of mining in Canada in the deaths of Captain Robert C. Adams, of Montreal, and Howard West, A.R.S.M., of New Denver, B.C.

Captain Adams was prominently identified with mining in the Province of Quebec for many years, having been one of the pioneers in the Canadian phosphate industry of the early eighties. He was then managing director of the extensive properties worked by the Anglo-Canadian Phosphate Company, Limited, in the Buckingham and Perth districts. On the collapse of phosphate mining he became became interested in the mica trade and in metalliferous mining in British Columbia where he had extensive interests in the Boundary and other sections of that Province. He was one of the founders of the Quebec Mining Associatiou and for several years the active head of that vigorous organisation during the period when the owners of Quebec mining property were combatting the obnoxious mining legislation of the Mercier *regime*. He was also a member of the Canadian Mining Institute, but owing to failing health did not, in recent years, take any active participation in its work. Unassuming, genial and kindly, a thinker of no mean calibre, a man of undoubted ability, both as a platform speaker and as a writer, Captain Adams will be remembered with affection by the older mining fraternity of Quebec. By his death The Review has lost another friend, one of its oldest and truest, and a contributor who, in its early history, did much to help it forward to its present position. Captain Adams was born in Boston, Mass., in 1839, and at the age of fourteen entered the merchant marine, a profession which he followed successfully for many years. On retiring from the sea, as stated, he became actively interested in mining, taking up his residence in Montreal. He was president of the Canadian Secular Union, and of the Montreal Pioneer Freethought Club, and among his contributions to literature may be mentioned the following:—"On Board the Rocket," "History of England in Rhyme," "History of the United States in Rhyme," "Travels in Faith," "Pioneer Pith," etc.



THE LATE CAPTAIN R. C. ADAMS, MONTREAL.



THE LATE HOWARD WEST, A.R.S.M. NEW DENVER, B C.

The Review extends to Mrs. Adams and to his son, Mr. Walter Adams, M.E., its heartfelt sympathy in their sore bereavement.

THE LATE HOWARD WEST.

We were greatly shocked the other day to read in a western paper of the sad death by drowning of Mr. Howard West, A.R.S.M., of New Denver. Mr. West had gone for a swim in Slocan Lake and it is thought had taken cramp while in the water. The late Mr. West was an Englishman, a graduate of the Royal School of Mines, who came to Canada about ten years ago and began practice as an assayer at New Denver, He was a singularly lovable character, upright and honorable in all his dealings, and was immensely popular in the Slocan.

Table 2 shows the gross value of the mineral output for each year, and is particularly intended to illustrate the growth of the mining industry from year to year. From this it will be seen that in the last ten years the output has increased from $2,978,530 in 1892 to $20,086,780 in 1901, and this increase has been gradual and steady, the result of new properties added to the producing list each year, and the increasing development of the older properties.

The increases for each year from 1896 over that preceding are shown below:—

	Increase over previous year.	Per cent. increase.
1896	$1,864,914	33
1897	2,947,312	39
1898	451,593	4⅓
1899	1,486,270	13⅔
1900	3,951,620	31⅛
1901	3,742,029	23

The per capita mineral production of the Province for 1901 was $134.

Table 3 gives in detail the amount and value of the various mineral products for the past three years. As compared with 1900, the production for 1901 shows, for:—

Placer Gold	a decrease of	27⅛	per cent.
Lode Gold	increase of	26	"
Silver	"	25	"
Copper	"	175	"
Lead	decrease of	25½	"
Coal	increase of	1½	"
Coke	"	49	"
Other Materials	"	22⅜	"

Table 4 shows the gross value of the mineral products for the last three years produced by the various divisions and districts, and illustrates the growth of productive mining in the various parts of the Province.

Table 5 shows the yearly production of placer gold since 1858, showing a grand total to date of $63,554,543. In this is included gold obtained by placer mining, hydraulicing, and dredging.

Table 6 shows the production of the lode mines of the Province since 1887, which is the earliest period in which any lode mining was carried on, although it never amounted to anything appreciable until 1892.

While coal mining and placer mining are undoubtedly just as truly mining as is "lode mining," and the production therefrom is just as truly a part of the mineral output—still, in the popular sense, the term "mining" is confined to lode or metal mining, and for this reason this table is most interesting as indicating the growth of such "mining" in the Province.

That this growth has been phenomenal is shown by the following figures:—

In 1894 the product of the lode mines was valued at $781,342, while in 1901 it has increased to $13,683,044, or nearly 18 times as much in eight years

The product of these mines in 1901 is valued at $13,683,044, an increase over the previous year of $3,613,287, or equal to 36 per cent.

The tonnage of ore mined in 1897 was 169,362 tons; in 1898 it had increased to 215,944 tons, or about 27½ per cent. increase over the previous year. In 1899 it was 287,343 tons, or equal to 33 per cent. increase; in 1900 it was 554,796 tons, or 93 per cent. increase; in 1901 it was 920,416 tons, or about 66 per cent. increase over the previous year.

While this great increase in tonnage is chiefly due to the increased output of the mines previously working, still there have been a number of new shippers added to the list during the past year.

The following table shows the number of mines in each district which shipped during the past year:—

TABLE SHOWING DISTRIBUTION OF MINES SHIPPING IN 1901.

District.	No. of Mines Shipping.	No. of Mines Shipped over 100 tons in 1901.	Men Employed in these Mines.		
			Below.	Above.	Total.
Cassiar—					
Atlin	1	..	1	..	1
East Kootenay—					
Fort Steele	4	4	173	63	236
Other divisions	4	1	19	7	26
West Kootenay—					
Ainsworth	13	7	126	33	159
Nelson	11	8	282	211	493
Slocan	36	21	676	194	870
Trail	13	9	685	267	952
Others	8	2	39	27	66
Lillooet	3	3	29	14	43
Yale—					
Osoyoos, Grand Forks and Kettle River	17	14	501	227	728
Yale, Ashcroft, Kamloops	2	2	21	19	40
Coast	7	7	184	150	334
Total	119	78	2 736	1,212	3,948

Of the non-shipping mines the statistics are very incomplete, as very few of them report to the Department, and most of them are still in the "prospect stage." Returns have been received, however, from 47 mines in the Province which did not ship in 1901, and show that these mines employed 374 men; 227 below ground and 147 above ground.

Table VII shows the product of the metalliferous mines of the Province, giving in detail the tonnage mined in each division, together with the quantities and values of each of the metals so produced.

Table VIII gives the coal and coke production of the Province for each year from 1836 to date, showing a gross product of the value of $54,157,315.

Tables IX and X show, graphically, the mineral production of British Columbia for 1900 and 1901, as compared with the combined product of all the other Provinces for the same minerals during these years.

This shows that, of the total combined output of the various Provinces of the Dominion during 1901 (excluding the Yukon Territory), British Columbia produced—

82 per cent. of the gold, 96 per cent. of the silver
67 " " copper, 96 " " lead
2 " " iron, none " nickel
30 " " coal, 50 " " coke,

and of the total of preceding minerals about 49½ per cent.

Surely British Columbia is entitled to be called the "Mineral Province of Canada."

COAL.

The coal mines of the Province, have, during the past year, made an output never before equalled in their history. The gross output of coal was 1,691,557 tons, of which 221,226 tons were used to make coke, so that the net output for the year was 1,460,331 tons of coal and 127,081 tons of coke. This is equivalent to an increased production over 1900 of coal 1½ per cent., and of coke 49 per cent.

The sales of coal were as follows:—

Sold for consumption in Canada	413,705 tons
" export to United States	895,197 "
" " other countries	18,966 "
Total sales	1,327,868 tons (2,240 lb.)

The total sales of coke amounted to 127,533 tons, of which 80,154 tons were sold for consumption in Canada, and 47,379 tons were exported to the United States. This output has been made from the collieries on Vancouver Island and those near the Crow's Nest Pass. The detailed production of each colliery is shown in the reports of the Inspectors of Collieries. The coast collieries produced 1,262,744 tons of coal and 153,98 tons of coke. The Crow's Nest collieries produced 198,587 tons of coal and 111,683 tons of coke.

The conditions prevailing in these two districts are so different that they require to be noted separately.

In the coast collieries the output is limited by the market for the product, as these older collieries are better prepared to meet an increased demand. Of their product about 75 per cent. was exported, chiefly to California and mostly as coal. With the completion of the two smelters now under construction on the coast, the market for coke should be materially increased next year.

The Crow's Nest collieries are as yet new, and their output is limited, not by the market, which is unlimited, but by the undeveloped condition of the collieries and the limited transportation facilities, difficulties which are being removed with all possible speed, and next year will undoubtedly see an enormous increase in the output of these collieries. Of their product about 60 per cent. of the coal and 70 per cent. of the coke was consumed in Canada, the remainder going to the United States. It has been a constant struggle for these mines to meet the demands made on them for fuel, and every endeavour is being made to increase the output. There have been many complaints that the local demand for fuel was being neglected to supply the export trade. This difficulty will be obviated as the development and equipment of the collieries is increased. The figures show where the output was sold, and it is certain that next year a far larger proportion of the coal produced will be exported, as it is evident from the demand that it is much better than any other that can be obtained in those States immediately to the southward of British Columbia.

It will be noted that while these collieries only turned out 198,587 tons of coal to be used as such, they converted 180,768 tons into 111,683 tons of coke, selling it as such, so that the actual amount of coal mined was 379,355 tons.

GOLD.

These statistics show that the gold production of the Province—including both placer and lode gold—for the past year, was of a value of $5,318703, which is an increase over that of 1900 of $586,598, or equal to about 12 per cent. increase. This is the greatest gold production British Columbia has ever made. In 1900 the increase was 12½ per cent. over the previous year, and the increase this year over 1900 is 11⅘ per cent, showing the growing importance of the gold output of the Province. This production is derived from placer mining, including ordinary placer work, hydraulicing and dredging, and from lode mining.

The placer gold output for the year 1901 was $970,100—a decrease from the previous year of $308,624. This is accounted for by the fact that the Atlin production has again suffered a serious diminution; the ordinary placers are mostly worked out, and the hydraulic companies which should have been at work making an output, have managed to get into litigation among themselves and with individual miners, so that the season was practically lost. It is hoped and expected that by next season the existing plants, and those now under construction, will be able to work, and if so, the output of the camp will certainly be double.

The Cariboo district shows a considerably decreased production, which is due almost entirely to the small output of the largest company in the district, the Cariboo Consolidated, which, through shortage of water, was only able to work a part of the season. This shortage of water was occasioned by the sudden melting of the snow in the spring, leaving insufficient water for the latter part of the season. The snow usually retained on the mountains is, as a rule, a sufficient reserved supply to last through the season, but last year this all melted at once, causing spring freshets and a dry summer season. The smaller companies in the district did well, and with a normal snowfall and spring all should make a very good showing next season.

A small output has been made from the Liard Division, but as last year was the first year of the operations of the hydraulic companies there, most of the work was preparatory and of the nature of development. On the coast certain deposits of black sand have been worked to a profit, but have not made the output expected.

Dredging for gold, although it continues to receive much attention and large amounts have been invested in capital, has not as yet yielded any very material return or output. That the gold exists in the beds of many of the rivers in considerable quantities has been conclusively proved many times, but the difficulty seems to be to save it. It might be pointed out that in every instance, as far as is known, the dredges operating in British Columbia work up stream, and it is very questionable if such a practice is best suited to the conditions here prevailing, or whether they should not, on the contrary, work down stream. In most of our rivers dredging is done under the following conditions, viz.: A swift current, numerous boulders, fine, flaky gold to be recovered and finally a hard, undredgable, and uneven bedrock.

It is submitted that, under these conditions, a dredge working up stream cannot be expected to save or take up all the gold. The agitation of the river bed by the buckets is great, and the gold will and is bound to settle into crevices in the bedrock. A very small crevice may hold the profits of a month, from which in a hard bedrock it is impossible for a dredge to recover it. Any gold once raised and afterwards dropped is swept by the force of the current back of the dredge bucket and is consequently lost. On the other hand in working down stream a "face" is formed which will be more or less inclined; the gold is swept from the bedrock on to this inclined face of removable material, and would be taken up in a subsequent bucketload.

Placer mining is, of necessity, dependent on the weather, and is as variable in this Province as that commodity, but in lode gold mining, as the mines develop, the production becomes as regular as the output of a manufacturing business, and it is to lode mining that the Province is indebted for its ever increasing gold production. In 1901 the lode mines of the Province produced $4,348,603 in value of gold, an increase over the previous year of $895,222, or 26 per cent. When it is remembered that this increase follows an increase in 1899 of about 30 per cent., and in 1900 of 21 per cent., a fair idea may be formed of the development and growth of the industry. This great increase is due first and chiefly to the development of the Boundary District, but the increased tonnage of the Rossland and Nelson districts has also had its effect. Approximately, this gold has been derived from:—

Direct smelting of copper-gold ore, - -	$3,474,738
Combined amalgamation and concentration	873,865
Total - - - - - -	$4,348,603

It may be said that no absolutely "free milling" gold property is working in the Province; they all carry sufficient values in sulphides to necessitate the saving of such.

SILVER.

The total amount of silver produced in 1901 was 5,151,333 ounces, valued at $2,884,745. This is an increase over the previous year of $575,545 in value. The silver production of British Columbia this past year has been affected in two ways and requires some explanation. Silver is derived from silver-lead ores and from copper ores carrying silver, with a small percentage of "dry" silver ores. In 1900, approximately 90 per cent. of the silver produced was derived from silver-lead ores, probably including most of the "dry" ores, as they were chiefly smelted together and are impossible to separate in the statistics. This year there has been a falling off in the production of lead ores, and a consequent diminution of the silver production, which has, however, been more than offset by the greatly increased tonnage of the copper-silver ores.

As near as can be estimated, the copper-silver ores have this year produced 30½ per cent. of the silver output. The production of "dry" ores, although proportionately small, has greatly increased, but it would be difficult, as before stated, to separate, with any degree of accuracy, this source of production from the others.

LEAD.

The production of lead was this past year 51,582,906 lbs., worth $2,002,733. This shows a decrease in value of $689,154, or about 25 per cent. as compared with the production of 1900, but in fairness the comparison must not stop here; it must be remembered that in 1900 there was a phenomenal increase over 1899 of 206 per cent. The figures show, therefore, that the lead production of 1901, although showing a decrease as compared with 1900, shows an increase over 1898 of 86 per cent., and over 1899 of 128 per cent., and is still 25 per cent. higher than the highest production of any year prior to 1900. The cause of the decrease is not attributable to the mines themselves, but to the condition of the market for lead ores—too large a question to go into here—which has temporarily rendered it unprofitable to mine large deposits of galena very low in silver. Reference is here made particularly to the lead ores of East Kootenay. The Slocan district has not been so seriously affected by the low price obtainable for lead ores, as the ores of this section carry much higher silver values, which has enabled them to be mined and marketed at a profit. As a matter of fact, the Slocan has this year just held its own as regards tonnage of ore mined and values produced.

COPPER.

Each year seems to present some particular feature of interest, and this year it is the greatly increased copper production of the Province. The copper production for the year has been 27,603,746 lbs. of "fine copper," valued at $4,446,963, an increase of 17,606,666 lbs, and $2,831, 674 over that of the previous year, or about 175 per cent. increase in value.

It may here be noted that the recent "break" in the copper market did not occur until the last month in the year, and as, in estimating the values as above, the average price for the year is employed, the value of the product has not been seriously affected.

This copper has been derived as follows:—

Boundary district	14,511,787	lbs.
Trail (Rossland) "	8,333,446	"
Coast "	3,115,872	"
Nelson "	1,599,449	"
Other districts	43,192	"
Total	27,603,746	lbs.

The great increase has been due to the working of the exceedingly large and notoriously low grade copper ores of the "Boundary," which has been rendered possible by the material reduction made in the actual costs of smelting, which are authoritatively stated as having been reduced as low as $1.35 to $1 50 per ton of ore. This low possible cost of the first smelting, now proven, has a wide effect on the future of the district and Province, as it brings within the limit of profitable ores many known deposits of great extent which it has been previously regarded as impossible to profitably treat.

IRON ORE.

It has to be recorded that, as yet, very little iron ore as such has been mined in the Province. There have been a few experimental shipments made and a considerable amount of development work carried on, but from the very nature of things iron ore to be handled at all necessitates an iron blast furnace to treat it, which is, as yet, not an accomplished fact in British Columbia, and will not be until a sufficient development has been done to fully establish both the quantity and quality of ore supply to justify its erection.

The statistics show that 5,746 tons of ore were shipped, which, as before stated, were used for experimental purposes, or as a flux in smelting other ores.

OTHER MINERALS.

There has been a small quantity of platinum produced this year, about $457 worth, from the Similkameen District. This small output is occasioned by the fact that comparatively little placer gold mining has been going on in this district of late, and as the platinum is recovered with the placer gold, little has been produced. This metal has been again noted in the neighborhood of Dease Lake and on the Thompson River in the placer workings, but no record has been obtainable of any quantity having been saved.

No reliable returns are available as to the production of the various building materials, including lime, brick, fire-clay, building stone, cement and tile pipes, and the amount credited to these materials in the statistics has been estimated—the estimate erring on the conservative side.

Lime and brick are produced locally in almost every district for home consumption, while on the coast an excellent lime, which has considerable sale abroad, is made from a marble. On the coast, too, a cement of very good quality is made, and supplies much of the local market. On Kootenay Lake a coarsely crystalline marble quarry is being worked for building purposes. There are on the coast several first-class granite and sandstone quarries open and doing a local trade. These quarries are so admirably situated as regards water transportation that there is a fair prospect of their becoming an important export industry. Fire-brick, drain pipes and tile are manufactured on Vancouver Island for home consumption."

SILVER MINING IN ONTARIO.

An Important Consolidation of Some of the Mines of Lake Superior.

The production of silver from the Thunder Bay District of Lake Superior, which a few years ago occupied a very prominent position in the mineral production of Ontario again gives evidence of its old time vitality. Last year the total production of this metal in Ontario was 151,400 ounces, worth $84,830, as against 160,612 ounces valued at $96,367, in 1900. Consolidation has recently taken place, by which the West End, Porcupine, Badger, East End and Keystone mines have passed into the hands of a new company which promises to greatly augment the mining operations hitherto carried on in this section of Lake Superior. This company, known as the Consolidated Mines Company of Lake Superior Limited, was incorporated in Ontario a year ago with an authorized capital of $1,000,000, and is a combination of American and Canadian capitalists. The total area of the silver-bearing properties acquired

comprises something over 1,800 acres, upon which the mines above mentioned are located. In connection with the photos shown in our illustrated supplement this month, the following notes regarding the past history of these mines will be of interest to readers of the REVIEW:

THE PORCUPINE MINE.

This property consists of Mining Location 96 T, containing 160 acres, and was worked in a spasmodic manner and with a very irregular force for about a year previous to 1887.

A good wagon road to connect with the Canadian Pacific Railway at Murillo Station, and communication with Port Arthur, was built, and in addition to the erection of the necessary camp buildings, some drifting and test-pitting work was done on a vein from 2 ft. to 6 ft. in width, from which there was extracted over $15,000 in ore that for the most part consisted of massive argentite and native silver, shipments of which were made to the smelters.

On the strength of these showings the property was sold for $50,000 cash, and the purchasers proceeded to open up the property by systematic development, blocking out the ore by drifts, shafts and winzes, and the property at the time of closing down (on account of litigation), was very fairly well opened up to commence stoping and milling. While this development was going on some 3,000 tons or more were stoped out above the adit level and milled at the "Badger" mill. Although no accurate figures or data were ever kept of this milling, it is believed, from the information gathered, and from statements made by the manager of the "Badger" at that time, that the ore averaged over 20 ozs. of silver per ton.

On the second level some very rich smelting ore was encountered in the vicinity of the main shaft.

The silver-bearing rocks of this district are those of the Lower Cambrian series known as the Animiki slates. They consist of black argillaceous slate, and are comparatively soft and easily drilled, the rate of drilling by hand being about four (4) feet per hour. Above these slates is a capping of hard massive basalt or trap rock, varying in thickness in different localities from 10 feet to 100 feet. The silver enrichment usually occurs below the junction of the trap with the slates, and is rarely found in the trap in any considerable quantities. The Animiki slates lie horizontally, and the veins, which are of the true fissure type, cut through both the slates and trap at a very steep angle or dip, usually 70° to 80°. The fissures are the result of the faulting of the rocks, and there is in nearly all cases a considerable displacement of the hanging and foot walls, the thrust varying from 10 feet to 60 feet. At the "Porcupine" the difference of level between the junction of the trap and slates on the foot wall and its corresponding point on the hanging wall, is 16 feet, and the depth of the trap capping on the higher side, that is, the foot wall, is 35 feet below the surface. The vein filling consists of a gangue of quartz, calcite and baryta, which in many places exist brecciated with portions of the slate country rock. These gangue constituents are mineralized to a greater or less extent in different portions of the same vein by iron pyrites, galena, argentiferous zinc blende, argentite (silver glance) and native silver. The argentite exists in the vein both in the nugget and leaf form, nuggets of solid silver as large as a man's head having been taken out. Native silver in both the wire and leaf varieties is also encountered, but is not so prevalent as the black sulphide of silver (argentite). A pale green and greasy substance locally known as mountain tallow, which is chemically described as a hydrated silicate of magnesia, is found impregnating both the vein itself and along its walls. This mountain tallow has been found to be intimately associated with rich depositions of silver, and is always looked for as a good indication of the approach to a rich chute of ore.

The dark varieties of zinc blende are found to be highly argentiferous, running in some cases as high as 3,000 ozs. in silver to the ton.

Of the Porcupine mine in January, 1899, (after some additional development work had been carried out under my direct supervision while Manager of the "Badger" mine), I then reported as follows:—"You will notice by glancing at the accompanying underground plan of the Porcupine mine, the amount of ore available for stoping, as well as what has already been stoped out. Approximately, there is ore enough at present blocked out to keep a 10-stamp mill running for at least two years, and sinking the present shaft two hundred to three hundred feet deeper, would open up a very large ore body of a quality that will pay a handsome margin, over and above the expenses of milling and mining, and I confidently expect that a large amount of smelting ore will be encountered, such as had already been shipped when the mine was in operation last, with values running from 300 to 3,000 ozs. to the ton."

The above observations refer only to the Porcupine Mine proper. About 300 feet east of the Porcupine, but upon the same location and parallel thereto, lies the Porcupine Junior, an exceedingly large and well defined vein on which development work was done shortly before the mine closed down. A tunnel was run into the side of the mountain for some distance through the drift and alluvial overflow, striking solid rock formation and what was supposed to be the vein, the outcropping of which shows on top of the hill. This tunnel was driven for a total distance of 695 feet, 539 feet of which was on the vein and where it showed an average width of two feet, and was in places very rich in silver.

Some stoping was also done above this level, and it is estimated approximately that about $20,000 in silver was taken from these workings. Subsequently, it was determined, apparently, that this work was altogether on a "feeder" to the vein, which was intersected at about 40 ft. in, where it showed from 3½ to 4 ft. of solid and well mineralized vein carrying considerable native silver. No further work was done on this vein, but its characteristics are such as to warrant the belief that a very large body of rich ore will be found at or near the junction of the "feeder" with the main vein. This vein is a mine itself, the possibilities of which are as great as that of the Porcupine proper, and I have no hesitation in stating that it is possible, under intelligent direction, to place this property upon a paying basis with a comparatively small expenditure of money for necessary machinery and labor, and I am equally confident that upon further surface explorations upon this hitherto but partially prospected area, other argentiferous veins of equal merit will be discovered.

The present company took possession in July, 1901. The mine was pumped out, and after a very small amount of exploration work was done, shipping ore of the very highest grade was found to exist in several places. In one place in particular there exists 6 inches of ore that is as nearly solid silver as it is possible to be. From one place a small piece of ground was stoped out, and a test shipment of 13 tons made to the smelter at Omaha. The ore was roughly sorted into two grades, the higher grade running 396.72 ozs., and the lower 60.20 ozs. of silver to the ton. The development work since July has consisted of the extension of the second level, both east and west, in driving which some very rich ore has been encountered; one chute in particular was struck November 4th carrying a 12-inch pay streak of ore assaying 8,866 ozs. to the ton. This development has increased the amount of ore blocked out by some 3,000 tons. It is proposed to sink the main shaft 30 feet deeper and to open up another level immediately, as rich ore exists in the bottom of the shaft, which is at present 40 feet below No. 2 level. The total amount of development on the main Porcupine consists of 1,690 feet of drifting and 250 feet of shafting.

PLANT.

When the company took over the property in July, no plant existed on the property. Since then an excellent hoisting plant, capable of handling 200 tons or more per diem has been installed, with engine house, shaft house and ore houses, all constructed of good design and

workmanship. The engine house, landing stage in the shaft house, and the underground workings, are lighted by electricity, the electric plant having a capacity of 50 lights.

There are also on hand some 300 cords of wood. The steam capacity, being 80 horse power, is sufficient to supply power for a 10-stamp mill in excess of what is now being used for the hoisting plant. The mine being a particularly dry one, no trouble is experienced with water, although a duplex pump of 170 gallons per minute capacity is installed, and would be capable of handling the water even when the workings are largely increased.

A number of the houses which stand on the Badger property were repaired, so that ample housing capacity is available even for a much larger force of men, and a small outlay will further increase this to a capacity of 150 men if required. There are in all some 40 buildings, including houses, stores, stables, sleeping and cook camps, and offices on the Badger and Porcupine properties.

The engine house and blacksmith shop is thoroughly equipped with all the necessary tools to handle what work is met with in the ordinary course of events. For heavier work, a machine shop and foundry at Port Arthur are easily available, and prompt service is rendered.

The transportation problem, which in the early history of the mine was a very serious and expensive one, necessitated a haul by team a distance of 12 miles, over bad and hilly roads, of supplies coming in and ore going out. This is now a very simple matter, as a good wagon road of 1½ miles connects the mine with Silver Creek station, on the line of the Canadian Northern Railway, Duluth extension, from which point trains run into Port Arthur, a distance of 28 miles.

As to this important matter, conditions here are exceedingly favorable to the miner. The rock, unlike the usual rock met with in gold and silver mines, is comparatively soft, and work can be accomplished as quickly here by hand drilling as in some other localities by machine drilling. Transportation expenses are reduced to a minimum, being only $2 to $7 per ton. Mining labor is paid $2 per shift of ten hours; no labor union or labor troubles exist. Fuel costs from 90c. to $1.10 per cord, delivered at point of usage. Drifting contracts can be made for $5 to $6 a foot; sinking, $8 to $12. Dynamite costs 15c. per lb. The mines being in a farming community, cheap farm produce is therefore available. In view of all these favorable facts, the total mining and milling costs, with proper management, ought not to be in excess of $2 per ton, with a milling capacity of 50 tons a day, and as the ore is expected to run between $8.50 and $11.50 per ton, the margin for profit is ample.

PORCUPINE JUNIOR.

On this vein a development tunnel was driven some 695 feet, from which some very rich silver ore was taken out as a result of the work, amounting to $20,000. Three years ago, when the Porcupine passed into the hands of the owners previous to the present consolidated company, they figured that by driving a cross-cut tunnel at a lower level than the Porcupine Junior tunnel they could intersect this vein, and thereby open up a large amount of shipping ore, which would be available without the expense of any plant whatever. They therefore drove the tunnel shown on the map some 419 feet, with the result that, not having had any accurate surveys made, when they struck a small stringer of only a few inches wide at the point marked "O," they supposed they had reached the vein they were seeking; they then drifted on it for 137 feet, and not finding anything of value abandoned it. A survey of this tunnel and the Porcupine Junior tunnel shows the two workings to be in the portions as indicated on the plan, and by cross-cutting at the point marked "Proposed Cross-cut," the Porcupine Junior vein will be struck, allowing for the dip of the vein, in about 40 feet.

By cross-cutting from the main shaft of the main Porcupine, a distance of about 200 feet, the Porcupine Junior could be brought into connection with the present hoisting plant, and the ore taken to the mill that way.

Between these two veins there ought not to be the slightest difficulty in keeping a 20-stamp mill, with a capacity of 80 tons per diem, pounding steadily for several years. It is also very probable that a small outlay on diamond drilling would open up other rich veins, as other faults in which all these veins occur are known to exist, but have never been exploited.

THE BADGER MINE.

Consisting of Mining Location 201 T and part of 200 T, contains 200 acres, and joins the Porcupine and Keystone above described. From the fall of 1887 until the close of that year, in addition to the erection of camp buildings, about 100 feet of drifting was done during which initial work an unusually rich body of silver was encountered. Up to the end of March, 1889, the work consisted chiefly of sinking a shaft 280 feet; over 2000 feet of drifting and 190 feet of winzes and air shafts were also carried out, besides some stoping between the first and second levels, where extremely rich ore was struck, some of which assayed over 19,000 ounces of silver to the ton. Up to April 1st, 1889, about $65,000 had been expended, and $267,000 worth of silver taken from the mine. An average of thirty men were employed and the surface buildings, shaft house, shops, stables, officers' quarters, rock house, and a complete stamp mill, with a daily capacity of 30 tons, were completed.

The mine is situated well within the centre of what has been termed the "Silver Constellation," and the general character and strike of the veins correspond very closely with the Porcupine veins.

THE KEYSTONE.

The Keystone was, until the construction of the new colonization road and spur thereto via Badger and Porcupine, not quite so accessible as its immediate neighbours, and preliminary and other work of development carried on there was done in a quiet way. The Keystone has an area of 160 acres of splendidly wooded land, and has three veins upon it, known as Nos. 1, 2, and 3. upon which the development work up to date consists of drifting 325 feet first level on No. 1, and about 330 feet of sinking and drifting in No. 2. Vein No. 1 is a most pronounced one, and its ores are rich in native silver. Veins 2 and 3 have produced some of the richest native silver that was as remarkable for its variety and beauty as anything yet brought to light in this or any other known district. It is estimated that about 20,000 ounces of silver in the smelting ore were extracted from the different workings, while at least 950 to 1,000 tons of milling ore remain upon the dumps, all of which shows rich in silver.

SILVER MOUNTAIN WEST.

Silver Mountain West, or "West End Mine," consists of Mining Location R 55, R 56, R 57, and 178 T. The mine is equipped with a modern 10-stamp Fraser and Chalmers gravity mill, with a capacity of forty tons per day; one Copeland & Bacon double cylinder hoist, 8 x 10, and locomotive type forty horse power boiler; one single drum, 8 x 10, hoist, one vertical boiler, thirty horse power; pumps of the capacity of 250 gallons per minute; fully equipped blacksmith shop, all necessary tools, etc.; fine office building, large boarding house, sleeping camp, also twenty dwellings, one store building, stocked with merchandise and supplies for the men, stables, two teams of horses, with the necessary harness, sleighs, wagons, etc., etc.

An exceedingly strong vein cuts nearly squarely through the ridge of summit of Silver Mountain in its almost east and west course, dipping towards the north. This vein is the direct extension of the well-known "East End" of Silver Mountain, to which the original Indian

(Continued on page 218.)

THE SULPHIDE ORE BODIES OF THE SUDBURY REGION.



Canadian Copper Company's Froude Mine, five miles from Sudbury, Ont.

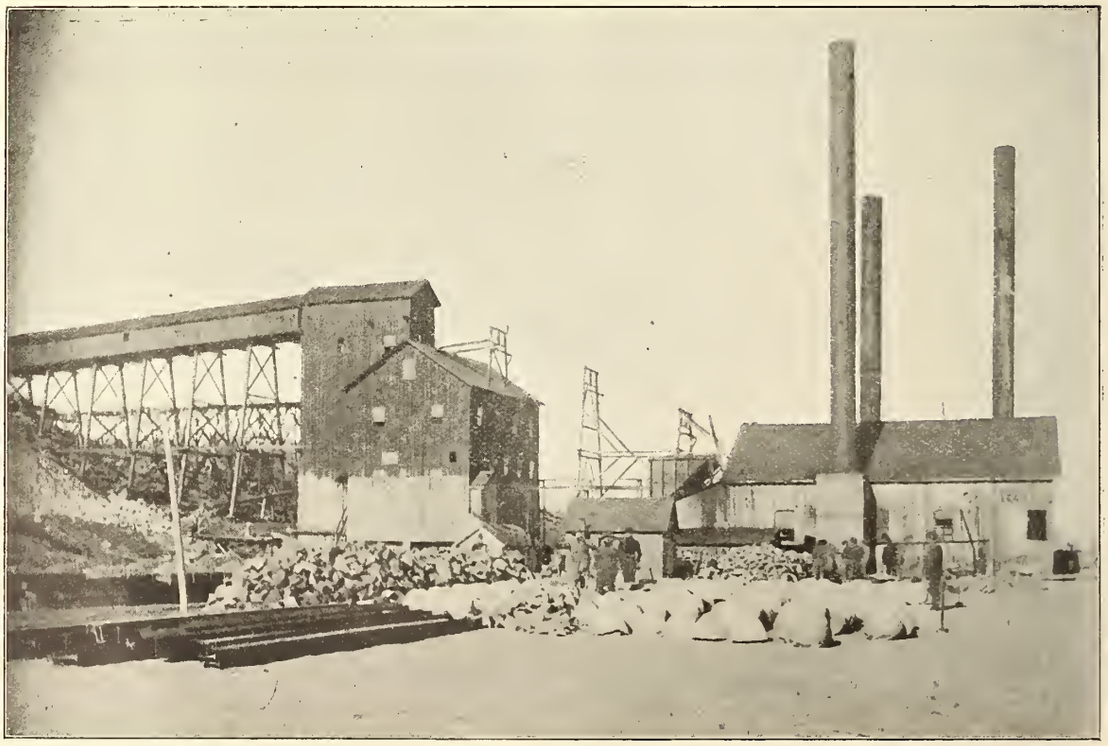


Shaft House Creighton Mine, eight miles from Copper Cliff, Ont.

THE SULPHIDE ORE BODIES OF THE SUDBURY REGION.

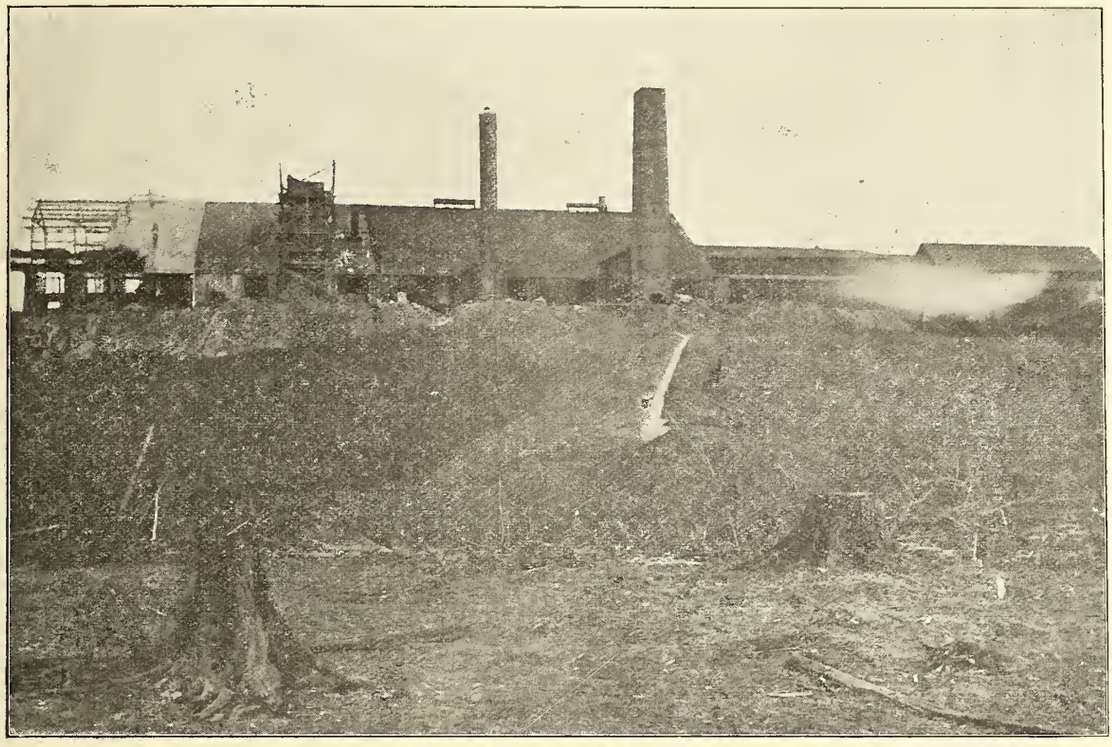


The Gertrude Nickel Mine of the Consolidated Lake Superior Co., situated thirteen miles from Sudbury, Ontario.

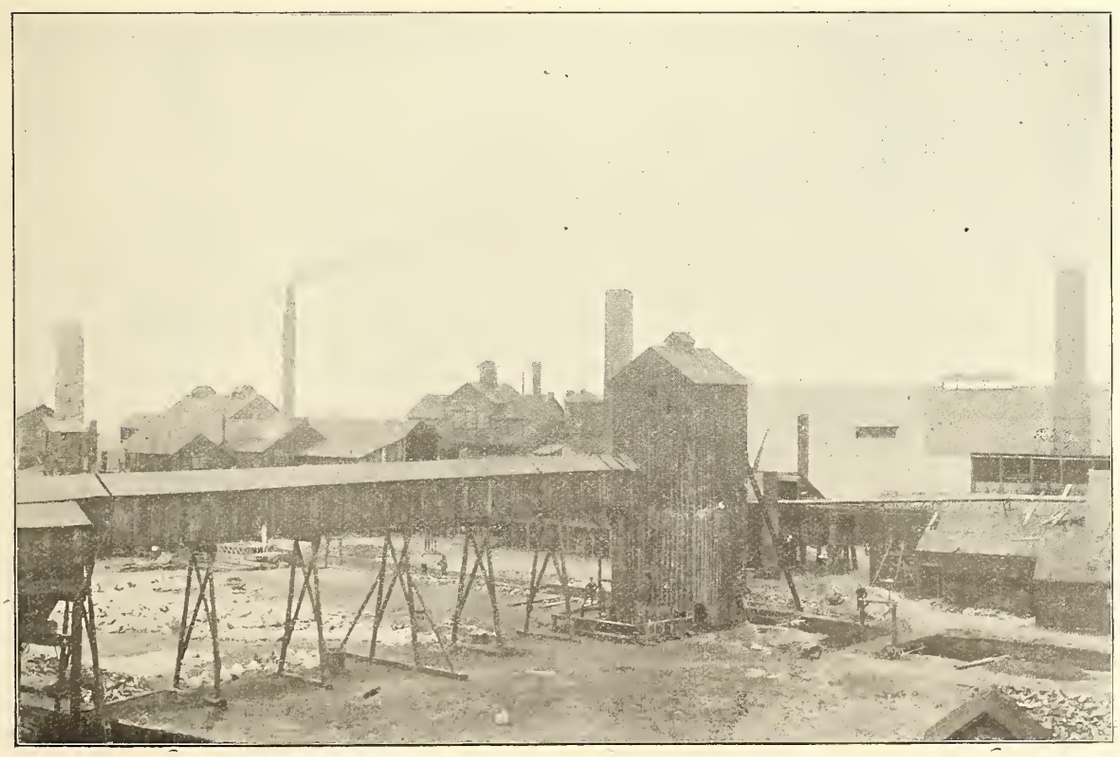


Matte Yard at West Smelter, Canadian Copper Co., 1,000 tons of matte ready for shipment. No. II Mine rock-house in background.

THE SULPHIDE ORE BODIES OF THE SUDBURY REGION.

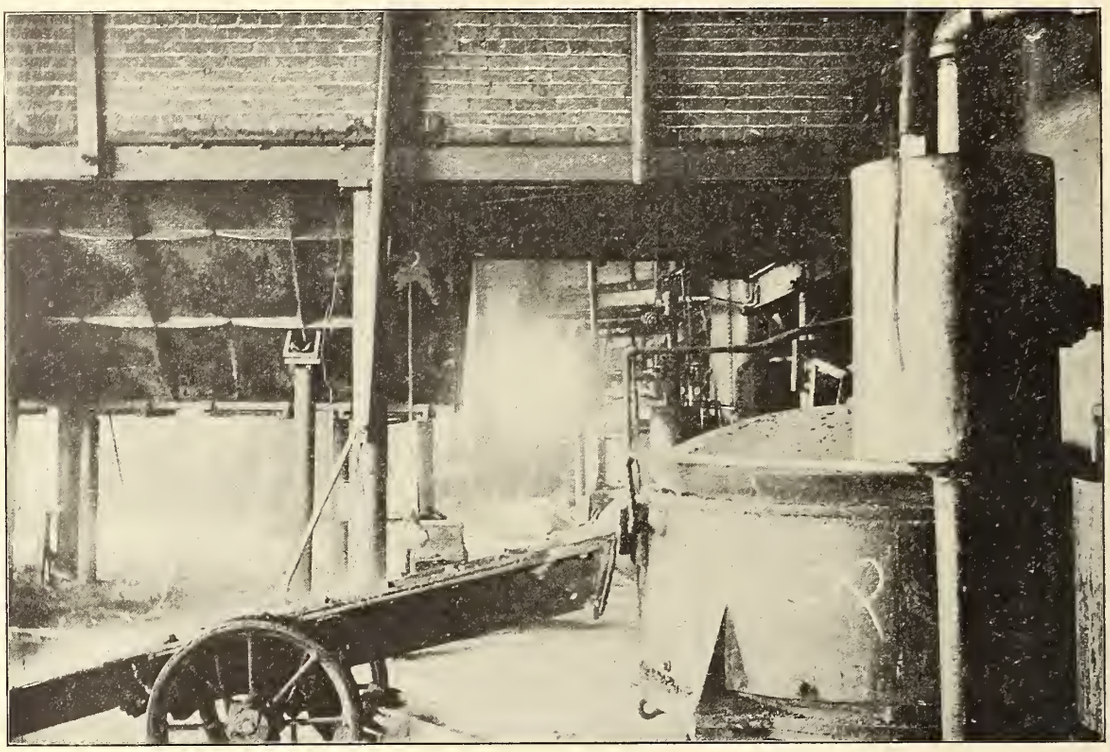


West Smelter of the Canadian Copper Co., showing Slag Heaps in the foreground.



Partial view of East Smelter of the Canadian Copper Company, Copper Cliff, Ont.

THE SULPHIDE ORE BODIES OF THE SUDBURY REGION.

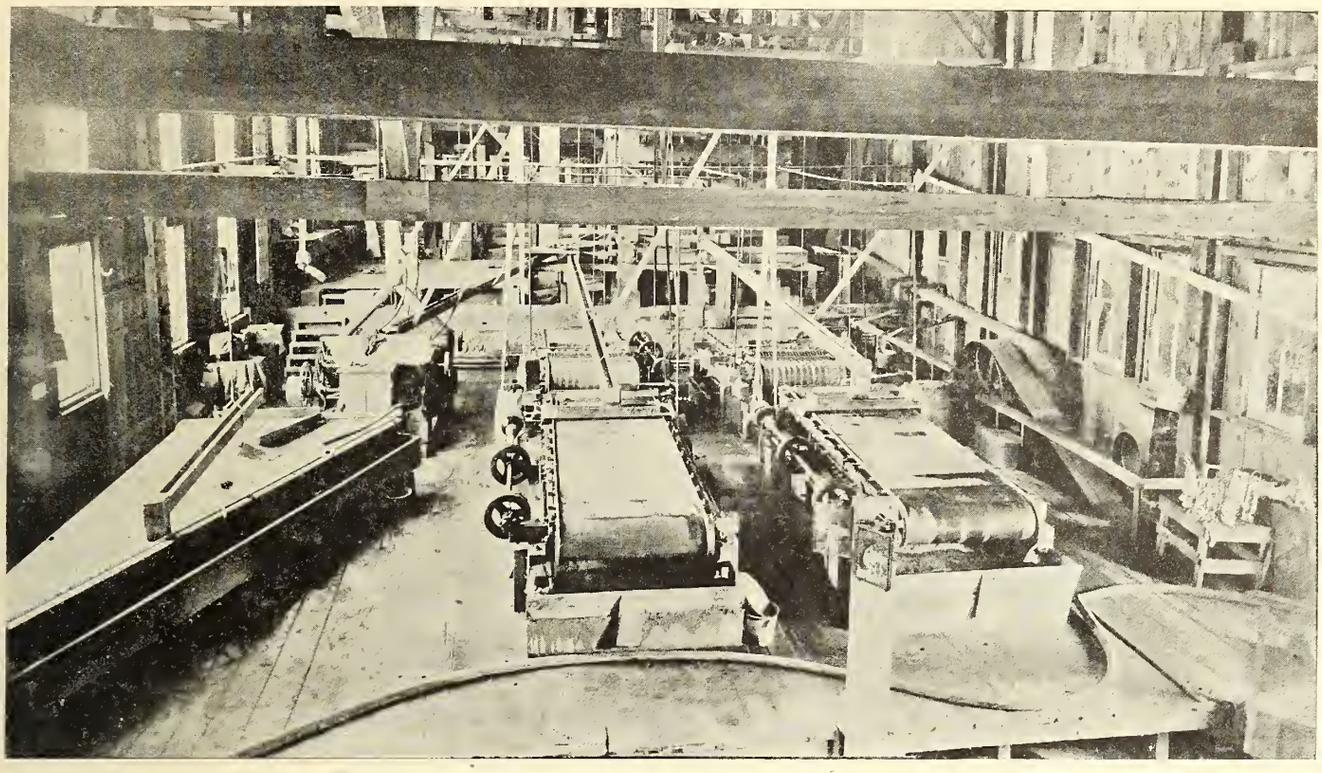


Interior of West Smelter, Copper Cliff, Ontario.



Construction of Canadian Copper Company's branch line to Creighton Mine.

SILVER MINING IN ONTARIO.



Consolidated Mines Co. of Lake Superior—Interior of Battery at West End Silver Mine.



Consolidated Mines Co. of Lake Superior—East End Mine.

SILVER MINING IN ONTARIO.



Consolidated Mines Co. of Lake Superior—West End Silver Mine.



Consolidated Mines Co. of Lake Superior—Stamp Mill at West End Mine.

SILVER MINING IN ONTARIO.



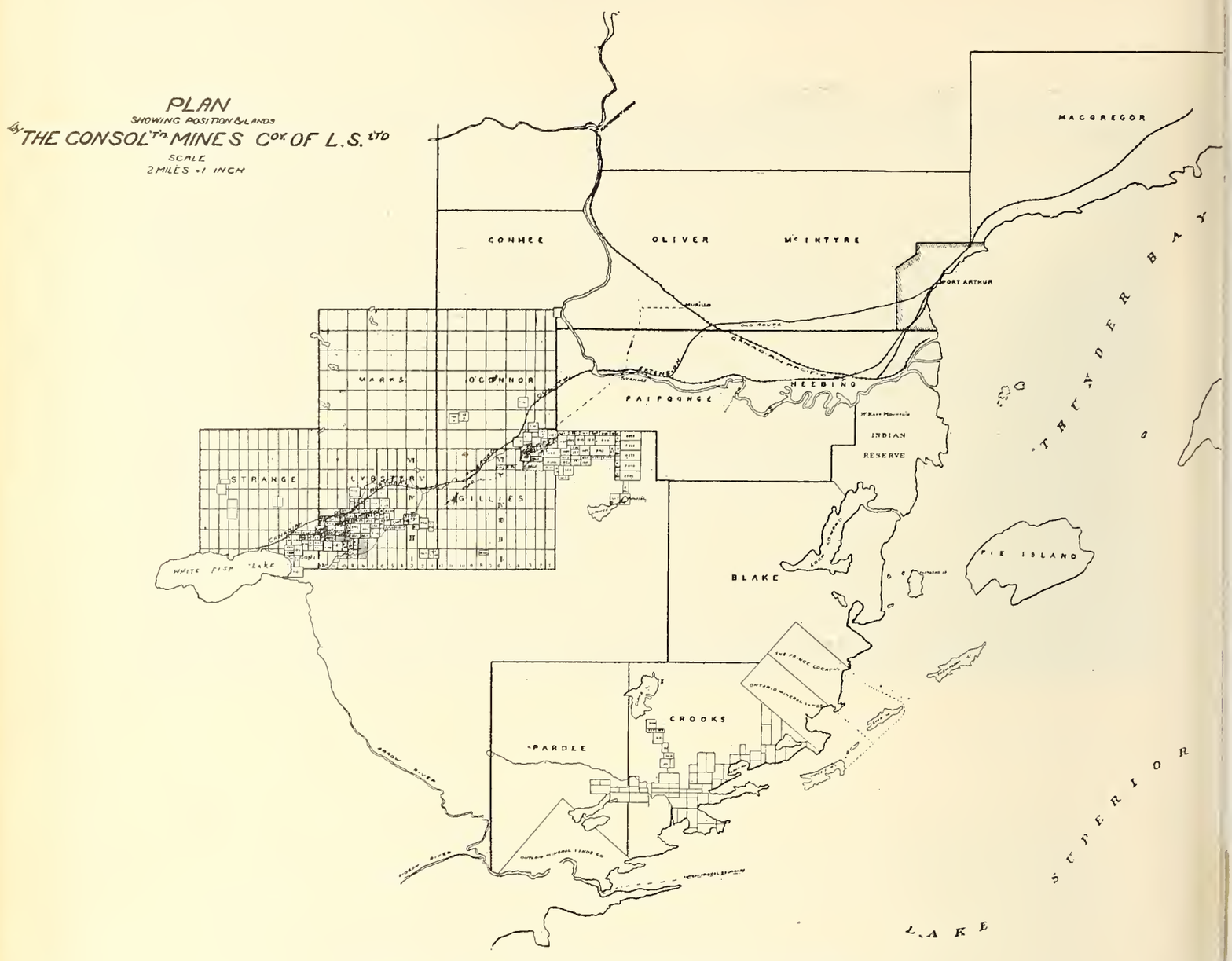
The Badger Mine.

*Showing Stamp Mill and Tramway.



Consolidated Mines Co. of Lake Superior—Badger Stamp Mill.

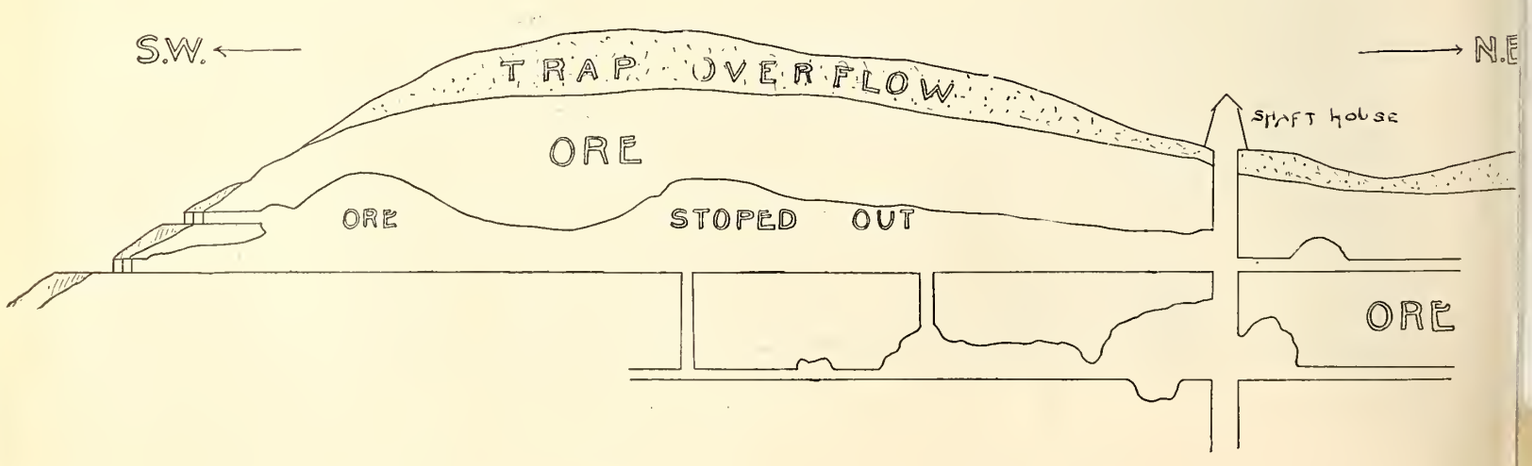
SILVER MINING IN ONTARIO.



THE PORCUPINE MINE

THE UNDERGROUND WORKINGS

SCALE - 50 Ft. = 1 INCH



THE SYDNEY COAL FIELD, CAPE BRETON, N.S.

This map showing the land and sub-marine areas and the location of the various Collieries of the Dominion Coal Co., Limited, the Nova Scotia Steel and Coal Company, Limited, the Dominion Iron and Steel Company, Limited, and other operations, has been specially drawn for the REVIEW from the records and surveys of the Geological Survey of Canada.

The land area occupied by coal-bearing rocks in the Sydney Coal Field has been estimated at two hundred square miles, while an immense sub-marine area contains large seams of coal in workable condition, easily accessible. The coal measures have been folded into subordinate basins so as to bring the coal seams to the surface under the most favorable conditions for their extraction and shipment. The whole coast is deeply indented by bays and channels approximately coinciding with the axes of these folds, affording in the sea cliffs numerous natural exposures of the coal seams and accompanying strata, and constituting excellent harbors, one of which, Sydney Harbor, situated towards the centre of the district, is one of the finest in the world.

Taking the average of all the sections, the total number of seams in the productive measures is twenty-four, of which six are three feet or upwards in thickness, and the total average thickness of coal may be stated at forty-six feet. The similarity and persistency of the seams over great areas is very remarkable, although local variations are frequent. There is, therefore, no great uncertainty in regard to the equivalency of the various seams at different points. They generally dip at a very low angle, and are little affected by faults and disturbances. The coal is of the soft, or bituminous variety, with comparatively little diversity in the quality of the different seams, all of which yield a coal exceedingly well adapted for steam and domestic purposes, while that of some of them is especially applicable to the manufacture of gas.



Comparison of Costs of Compressing Air with Steam and Electricity at Rossland, B.C.*

By Mr. Wm. Thompson, Rossland, B.C.

Compressed air has become so generally used in connection with mining operations, and so well recognized as the most useful and economical power, with its unlimited range of uses, and special adaptability to underground work, that an introductory to this paper on the subject would be superfluous to mining engineers.

The comparative economy of prime movers for air compressing engines is, however, of great interest to all, and a subject on which any engineer can read with interest. This is particularly the case with engineers practicing in British Columbia, where a large number of the mining problems include the extraction and reduction of large bodies of low-grade ores and the consequent necessity for a thorough study of economical methods for mechanical handling.

The general mobility of compressed air as a power allows a wide range of generators, or prime movers, but we can, in nearly all cases, rely upon having to adopt primarily, one of two sources of power, viz., water or heat.

Water, the first of these can, as we know, be used in many ways, each terminating finally at the mine, as compressed air ready for service. The initial water power may come from one or more sources situate either at the mines or many miles distant, and can be used either as a directly connected unit of power for the compression of air, or as a prime mover for some intermediary power.

British Columbia has been fortunately blessed with magnificent water power, more particularly in the Kootenays. In many cases these water powers are situated close to the mines; in others, as at Rossland, they are several miles away.

Distances over which power can be economically transmitted by electricity are yearly becoming greater, until it seems that distance is no longer an obstacle, and it has become simply a question of capital investment to successfully transmit the power generated by water almost any distance.

Heat, the second great source of power for the generation of compressed air, has been successfully used as steam for many years, even in places which seemed to be utterly inaccessible either for the erection of the necessary machinery, or the securing of fuel after the machinery had been installed and made ready for operation. So accustomed have we become to surmounting difficulties of this kind, that we are apt to look with suspicion upon any suggestion to utilize distant water powers, preferring to resort to steam as being the power we best understand, and one which has been successfully installed and economically operated under very adverse circumstances.

British Columbia has been abundantly provided with fuel, in fact, we can say the supply of coal is practically unlimited. Enterprising capitalists, year after year, extend railways between the coal fields and the consumers, so that no producing or promising mining district has long to wait for an unlimited supply of this fuel. The mines at Rossland are exceptionally favored in this respect, all the leading mines having access to two lines of railways, and, through them, the coal fields of both British Columbia and the State of Washington.

Rossland is also favored by having the immense water power at Bonnington Falls, less than 40 miles distant, immediately available. The enterprise of Sir Charles Ross and associates in the West Kootenay Power and Light Co. have rendered this available for any service at each mine, as a competitor of the steam power, which mine managers would otherwise be compelled to adopt.

The question of the selection of power supply to be made by mine managers at Rossland is almost entirely removed from chance, and may be based on ascertained facts. Railways being at hand for the transportation of any kind of machinery, reasonably cheap fuel in quantities required is assured, and electric power for any size machinery or service is available. Therefore the problem simply resolves itself into "*Which of these powers will give the best service in operating the machinery used in connection with mining operations?*"

The same privilege applies to nearly every other mining district in Southern British Columbia; therefore, the writer feels that the results obtained in the air compressing plants at Rossland will be of special interest to the members of the British Columbia section of the Canadian Mining Institute, and mining engineers.

The steam and electric plants described below were modelled on the design and erected under the personal supervision of Mr. Bernard Macdonald, then general manager of the Le Roi and Nickel Plate mines, assisted by the writer. The steam plant was erected for the Le Roi Mining Company, Limited, and consists of the following, viz.:

Boiler Plants.—Two 250 horse-power Heine safety water tube boilers, arranged to burn coal as fuel. These were intended to generate steam to run the air compressors, and were set so as to work, if desirable, in connection with the nine 125 horsepower steel shell return tubular boilers, designed to operate the hoisting and surface plants. These boilers are arranged to be interchangeable to either service. A general description of this plant will be found in volume V., page 309, of the Journal of the Canadian Mining Institute.

During the test, the water-tube boilers were used at a guage pressure of 150 pouuds per square inch, using Crows Nest coal as fuel, which cost, laid down in front of the boilers, $5.55 per ton of 2000 pounds.

Air Compressing Plant.—The steam driven plant consisted of two compound condensing Corliss valve engines, direct connected to two stage air cylinders, equipped with intermediate cooling devices, each machine having a rated capacity of 4000 cubic feet of free air per minute, or a combined capacity of 8000 cubic feet of free air per minute at sea level.

A more detailed description of these engines would be as follows:

	No. 1 Engine INCHES.	No. 2 Engine INCHES.
Diameter, high pressure steam cylinder ..	22	22
" low " " " ..	36	36
" high " air " .	22	22
" low " " " .	36	38
Length of Stroke	48	48

Intercoolers, horizontal multitubular type; condensors, independent jet.

The Electrically Driven Air Compressing Plant.—This plant was erected by the Rossland Great Western Mines, Limited, and was originally intended to be operated in connection with the steam plant previously described, the intention being to supply power from a central station to four mines, owned by different companies. This arrangement would have given each mine power at the lowest possible cost, and have ensured continuous operations by reason of the compressing plant being arranged in separate units. Each company would pay its share of operation, maintenance, of plant, *pro rata* to its consumption of air.

When it was found necessary to erect the third unit to the compressing plant, unforeseen difficulties presented themselves in the shape of shortage of water for condensing and cooling purposes. On examination, it was found that a satisfactory supply could not be secured without heavy capital expenditures for erection of flumes, etc, to convey the water to where it was required for use.

It was, however, found that a supply of water, barely sufficient for the intercoolers and waterjackets, was available about three-fourths of

* Paper to be read at the Nelson meeting of The Canadian Mining Institute, 10th September, 1902.

a mile distant from the steam plant. This supply was so located that it must either be pumped or else the plant located at this distance away from the main steam plant. By conserving this water supply, cooling, and re-using, it was decided a sufficient supply of water for the air cylinder jackets, and intercoolers could be secured.

The results obtained from the steam plant had proven so satisfactory, that it was considered questionable if any electric plant could be installed that could successfully compete with steam, even when running non-condensing, unless very favorable rates for power could be secured. After negotiations with the Power Company, it was decided to erect an electrically driven plant, a short description of which is as follows :

Electrical Equipment.—Three phase, S.K.C., synchronous motor, designed for 2200 volts, with a rated capacity of 660 kilo watts, equivalent to about 825 horse-power. The motor is provided with a separate starting motor, mounted on the main frame, exciter and Italian marble switch-board, on which all operating switches and instruments are mounted.

There is a 54 inch Frisbee clutch set intermediate between the driving pulley and the motor. The motor is of a four bearing type, fitted with self-aligning and self-oiling sleeves. The entire machine is mounted upon a solid cast iron base set upon massive concrete foundations. The driving pulley is 60 inches in diameter, grooved for 22 1½in. ropes, and runs at 270 revolutions per minute.

The three compressors were built by the Canadian Rand Drill Company, of Sherbrooke, Quebec, and are especially designed for constant service.

The electrical equipment is also entirely of Canadian manufacture, the entire apparatus being manufactured by the Royal Electric Company, of Montreal, who are the Canadian manufacturers of the S.K.C. apparatus.

All tests were conducted under the personal supervision of the writer, and extreme care was taken to arrive at actual facts. Indicator diagrams were taken off both the steam and air cylinders every half-hour, and the results tabulated. Coal consumed was weighed, and all other supplies, such as waste, oil, etc., charged as used.

Readings were also taken and recorded by means of a delicately adjusted kilo watt metre, connected to the primary mains, of the amount of electric power used. The test extended over a period of thirty days, without interruption, both plants being run under exactly similar conditions as to air pressure.

Each of the plants tested being modern and representative of their respective types, gave an opportunity for a comparative test that rarely falls to the lot of an individual engineer under such favorable conditions, as to work being performed, and for this reason is the more valuable as data for basing calculations as to problems of power.

The average results of the thirty days' test is recorded in Tables I, II, III, IV, and V following :—

TABLE I.

Work Performed by Steam Plant.

Average iudicated horse power at steam cylinders of the combined machines	730 h.p.
Free air compressed per minute from atmospheric pressure to 95 lbs. per square inch	5432 cubic ft.
Free air compressed per hour	325,920 "
Average horse-power required at steam cylinders to compress 100 cubic feet of air per minute, to guage pressure	13.4 h.p.
Pounds of coal consumed during test	1,038,000 lbs.
Pounds of coal consumed per day of 24 hours	36,400 "
Average pounds of coal consumed per horse-power per hour during test	1.9 "

TABLE II.

Work Performed by Electric Plant.

Average horse-power registered at switch-board	540 h.p.
Free air compressed per minute from atmospheric pressure to 95 pounds gauge pressure	3,319 cubic ft.
Free air compressed per hour	199,140 "
Average horse-power required at motor to compress 100 cubic feet of free air per minute to 95 lbs. gauge pressure	16.3 h p.

TABLE III.

Cost of Operating Steam Plant.

Total cost of fuel consumed during test	$2,880 45	
" " wages for employes	710 00	
" " oils, waste, etc	147 30	
" " for 30 days, exclusive of maintenance and depreciation		$3,737 75
Cost per horse-power per month for fuel	3 96	
" " " oil, etc.	0 20	
" " " wages..	0 97	
		$5 15
Cost per horse-power per annum		$61 56
Cost for each 100,000 cubic feet of free air compressed		$1 56
Cost per drill shift		$1 25

NOTE :—80,000 cubic feet taken as the average consumption per shift of one 3¼" drill

TABLE IV.

Cost of Operating Electric Plant.

Cost of current for thirty days	$1,744 26	
" employees' wages	270 00	
" oils, waste, etc	73 00	
Total cost for 30 days, exclusive of maintenance and depreciation		$2,087 86
Average cost per horse-power per month		$3 87
" " " annum		$46 44
Cost for each 100,000 cubic feet of air compressed		$1 46
Cost per drill shift		$1 17

NOTE :—80,000 cubic feet taken as the average consumption per shift of one 3¼" drill.

TABLE V.

Showing Comparative Results between the Two Types of Compressors, based on each 100,000 cubic feet of air compressed from Atmospheric Pressure to 95 pounds Receiver Pressure.

Cost for each 100,000 cubic feet of free air compressed by steam plant (see Table III)	$1 56
Cost for each 100,000 cubic feet of free air compressed by electric plant (see Table IV)	$1 46
Result, saving by electricity over steam	6.4 per cent.

The saving shown in Table V would be affected adversely if the electric plant was operated singly and the entire air compressed was not used. For the reason that electrically driven compressors must be operated at constant speed, and loss of air at safety valve would be considerably increased over the same loss at steam plant, which could be run at the speed required to compress the amount of air actually required. This loss would, however, be slightly off-set by the increased cost per horsepower by working the steam compressors on underload.

I wish to draw special attention to the noteworthy results obtained from the system of intercooling used on the compressors tested.

In Table I it is shown that the steam plant required 13.4 horse-power to compress 100 cubic feet of air to 95 pounds gauge pressure per minute. The best power factor recorded that has come under the writer's notice, for doing the same amount of work by a two stage compressor, is 14.5 horse power, which shows a saving of 8 per cent. resulting from the use of specially designed intercoolers, for which the manufacturers are entitled to receive the credit.

How this result is obtained can be best understood by reproduc-

ing the average of a number of tests made on the efficiency of the intercooler during the progress of the power test. The results of these tests are shown in Table VI.

TABLE VI.

Temperature of cooling water at inlet of intercooler.....	42°F.
Temperature of cooling water at outlet of intercooler.....	50°F.
Rise in temperature of cooling water while passing through intercooler.....	8°F.
Temperature of air at outlet of low pressure cylinder and before passing through intercooler.....	196°F.
Temperature of air at inlet of high pressure cylinder, after passing through intercooler.....	54°F.
Reduction in temperature of air after passing through intercooler.....	142°F.

In conclusion, permit me to state that this paper has not been prepared with the idea of recording the performance of these two plants, except, in so far as comparisons can be drawn between the relative efficiency of the two systems, so that engineers, knowing local conditions, can have some record of actual performance before them.

The Sulphide Ore Bodies of the Sudbury Region.

By L. P. Silver, School of Mining, Kingston, Ont.

These deposits are unique from many points of view. When discovered first in 1883 they were thought to be enormous deposits of chalcopyrite which were to revolutionize the copper industry. Later they were found to be of more modern dimensions, but to contain good percentages of nickel, a metal worth several times as much as copper, and one for which, though the demand is now considerable, is ever increasing, and in all probability will be very great in the near future. These deposits are now the source of over forty-five per cent. of the total nickel production of the world, which in 1900 amounted to about 7500 metric tons, of which Ontario produced about 3540 tons, and New Caledonia about 3845 tons. They have been found on an area extending on the strike from Lake Wahnapitae for about forty-five miles in a south-westward direction and transversely from the "Soo" branch of the C.P.R. line north-westward for about twenty-five miles to the centre of Levack township. The ore bodies are lenticular in shape, pinching out in both directions, their elongation corresponding to the strike of the Huronian strata. The structure of their downward extension has not yet been proven, though the Evans mine, which was worked in the form of an open pit, was abandoned when down about 800 feet. There have been other mines in the district, which have been abandoned when down to about the same level, though it was not satisfactorily proven that other masses of ore did not lie below these a little off the line. The deposits have a general strike of north-east and south-west which conform both to the strike of the greenstone with which they are intimately associated, and to that of the Huronian series through which the greenstones cut. The presence of the ore bodies is indicated in nearly all cases by rounded hills of gossan, which occur at intervals for miles in a north-east and south-west direction. This being due to the formation of peroxides and hydrate-peroxides of iron from the decomposition of the pyrrhotite mainly, along with some from the decomposition of the chalcopyrite, of which two minerals the ore is chiefly composed.

The ore bodies may be grouped under three general heads:

First. Contact deposits of the sulphides situated between the granites and gneisses and igneous "greenstones," good examples of which are supplied by the Evans, Murray, and Copper Cliff mines. Under this head may also be grouped deposits situated between the greenstones and the quartzites, etc. The latter deposits are few, and their pyrrhotite is now believed to be almost barren.

Second. As impregnations of the pyrrhotite and chalcopyrite through the greenstones, which are often so rich as to be workable deposits, as in the case of McArthur No. 2 and No. 4 mines, the former of which has been worked in the form of a great open pit, 200 ft. long by 150 ft. wide by 300 ft. deep, while 100 ft. below this and connected by a shaft from the surface is a stope 75 ft. deep by about 45 ft. long by 40 ft. wide. The shaft is now down about 500 feet altogether.

Third. As segregation veins, which were filled subsequently to the eruption of the greenstones in which the writer believes the ore to have been first finely disseminated. Such veins are not very common, though portions of the more massive deposits have been dissolved out and redeposited along certain faults and fissures.

PETROGRAPHICAL CHARACTERS.

The greenstones are fine to medium grained eruptives, having a general greenish or greyish green color, from which they get their name. They vary in petrographical characters from a norite or gabbro to diorite or hornblende-granite. The diorite is probably secondary, as the hornblende seems to be derived from one of the members of the pyroxene group, the original rock being perhaps a gabbro. As a rule they show a gradual transition from what Vogt calls a typical pyrrhotite-norite on the one hand to a hornblende-granite on the other.

The writer examined a number of thin sections of the greenstones from around Copper Cliff which varied in petrographical characters as above, though nearly all were fairly acid, showing free quartz and micropegmatitic structure of the quartz and plageoclase, the latter being altered in places to calcite. Considerable orthoclase which was also much altered was found, and contained many inclusions zonally arranged, the outer edges in most cases being free from them. Among the inclusions quartz, mica, and apatite, and in several either pyrrhotite or chalcopyrite were determined. All but the latter seemed to have their longer axes arranged in two definite directions, which the writer believed to correspond to two of the pinnacoid faces. The darker silicates were determined to consist in some cases almost wholly of hornblende, while in others hornblende and hypersthene were closely associated; others again showed enstatite, bronzite, hypersthene, and augite to be present sometimes all in the one section. The hypersthene crystals have light central zones, and contain tabular inclusions assumed to be limenite; several also contain specks of chalcopyrite and pyrrhotite, and those nearer the deposits show stress by their bending and perfect cleavage at right angles to their elongation. Biotite is very abundant, and in some sections seem to invariably have greater or smaller inclusions of ilmenite, which has weathered around its outer edge to loucoxene and sphene. Apatite is also very abundant, and is found included in both the felspar and quartz. Sections within fifty or sixty feet of the deposits show a great deal of pyrrhotite and chalcopyrite to be included, which becomes more abundant as the deposits are approached, till just at the deposits they seem to make up a third or more of the section.

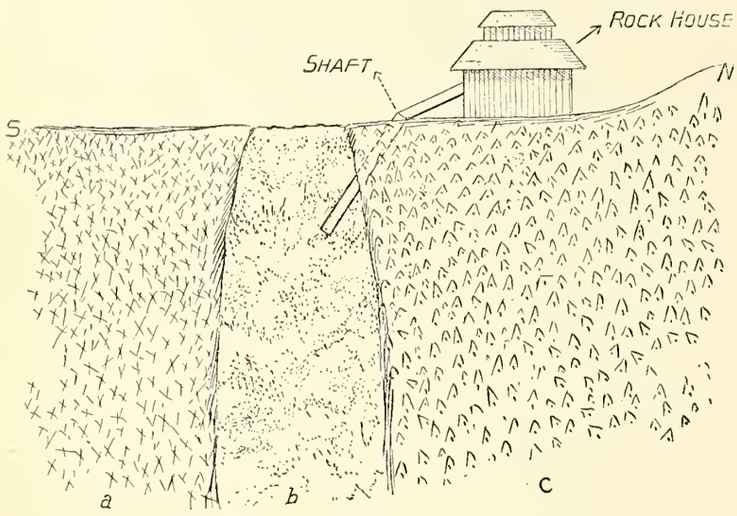
The chemical compositions of three typical samples of greenstone are:

	I	II	III
SiO_2	48.95 per cent.	49.83 per cent.	62.75 per cent.
Al_2O_3	16.21 "	17.28 "	18.21 "
Fe_2O_3 FeO.	12.15 "	14.85 "	4.64 "
CaO	7.41 "	7.01 "	3.61 "
Mg O	6.25 "	6.01 "	2.91 "
Na_2O	3.25 "	1.85 "	3.72 "
K_2O	2.70 "	2.20 "	1.31 "
Total...	96.92 "	99.03 "	97.15 "
Sp. Gr.....	2.88	.01	2.81

The greenstone areas vary in extent from a couple of hundred square yards to square miles, and cut through the rocks of the Huronian series, which are here represented by hornblende schists, quarzites, and slates, associated with which, and younger in age, are granites and gneisses, which, as a rule, bound the greenstones on the south-east and north-west. The deposits in most cases occur at the junction of the greenstones and the granites and gneisses as shown in a section of the Copper Cliff mine below.

The ore bodies consist of masses of chalcopyrite and pyrrhotite, very closely associated, distributed through the greenstone in specks,

SECTION OF COPPER CLIFF MINE.



(a) Greenstones; (b) Ore-body; (c) Granite.

which near the contact become more concentrated and assume the form of masses or stringers either inclosing or being inclosed by greenstone gangue. The ore, as it is brought from the mine, is mixed with about 50 per cent. gangue, and in the works of the Canadian Copper Company is crushed and then hand-picked to get rid of about 25 per cent. of such matter. A number of typical samples taken from each of four different mines now in operation were analysed and the average for each given below.

NO.	COPPER.	NICKEL.
1	5.25 per cent.	3.75 per cent.
2	2.75 "	3.72 "
3	2.68 "	3.62 "
4	2.20 "	1.25 "

In the same way an average of several samples from a property in each of four townships was taken and gave the following:

NO.	COPPER.	NICKEL.
1	0.89 per cent,	2.45 per cent.
2	0.35 "	3.01 "
3	0.60 "	2.05 "
4	2.75 "	2.86 "

Some of the ores run very high in nickel, as was shown by a small quantity of dressed ore shipped from the Worthington mine in 1891, which averaged 30 per cent. of nickel. The ores contain appreciable percentages of cobalt, and also of gold, silver, platinum, and palladium, which are all found in samples of the Bessemer matte of Canadian Copper Co. or the 80 per cent. matte of the Orford works An analysis of a sample of Bessemer matte is given below:

Ni & Co	39.64 per cent.
Cu	42.75 "
Fe	1.03 "
S	14.05 "
Ag	5.30 ounces per ton.
Au	0.75 "
Pt group	0.50 "

The nickel and cobalt in the ore is associated with the pyrrhotite, and up to about 3 or 4 per cent. probably replaces the iron in $Fe_7 S_8$, but in cases where the nickel occurs up to 10 per cent. and over it is probably present as pentlandite or at least has pentlandite distributed through it. This mineral is very abundant in the Crighten mine, and is easily detected by its perfect octahedral cleavage or parting and non-magnetic properties. Ferriferous polydymite was also supposed to contribute to the high nickel value in the ore, also millerite, a small quantity of which was found in the Copper Cliff mine. Other nickel minerals found in the region are gersdorffite (Ni As S) and niccolite (Ni As) from secondary quartz veins in the Worthington mine. In this connection the writer might mention that he has a specimen of diorite from the twelfth level of the Copper Cliff mine showing a good deposit of leaf-copper, which must have been formed by the reduction of the chalcopyrite by reducing solutions leaching through the rock. Several experiments were tried by the writer to determine the form in which the nickel is present in the pyrrhotite when small percentages only are present. Samples from different localities in the district were analysed, but in every case enough chalcopyrite was present to spoil the determination; even after grinding in an agate mortar and separating by a magnet, considerable percentages of copper were found. This, the writer believes, will be a great obstacle in the way of manufacturing nickel steel direct from pyrrhotite, for however free the deposit may seem to be from chalcopyrite, the two sulphides will probably be found to be intermingled in microscopic specks, and the smallest percentages of copper in steel exerts a detrimental effect on it.

GENESIS OF THE ORE DEPOSITS.

This theme has given rise to much speculation, but there now seems to be two recognized theories for their formation, to which the writer wishes to add a third, which might be said to be a combination of the first two, for he believes that in this, as in the disputes over many natural phenomena, both sides are right to a certain degree, just as were the Plutonists and the Neptunists of the time of Werner, and later the ascension and descension schools in connection with vein formations. In both these cases the theory which took into consideration the contentions of both sides was proven to be correct.

The first two theories are:

First. That the sulphides were concentrated along the contacts by sorets principal and the principal of convection currents.

Second. That the ore bodies were formed in the usual way by metasomatic replacement or segregation. To which the writer has added:

Third. That the sulphides are a constituent of the original magma, through which they were first finely disseminated, and were subsequently dissolved out and redeposited along the contact formed by the granite and gneiss by metasomodosis or segregation, these contacts being the points of least resistance for such solutions; or in some cases they may have been deposited in true fissures caused by the shrinkage of the granite dykes when cooling. (In many of the deposits there has been a secondary concentration along faults and fissures, probably caused by such shrinkage.)

In considering any theory for the formation of the ore bodies one is led into a discussion on the relation of the ore to the greenstone gangue with which even a superficial examination shows them to be related, the ore bodies being always fonnd either in the greenstones, near, or at the contact, of the greenstone and the granite or gneiss. A closer inspection shows the sulphides to be disseminated throughout the greenstone to quite a considerable distance from the main deposits, and to fade away by a fairly gradual gradation. That the sulphides

primarily came from the molten magma which composes the greenstone can be inferred from a megascopic examination of these rocks, and proven by a microscopic examination. A thin section of the specimen of this rock, as stated in a previous part of the paper, shows it to be impregnated with the sulphides, while in two sections which were examined by the writer, fairly fresh pyroxene and orthoclase crystals were found to contain inclusions of the sulphide, showing these minerals to have been formed previous to and out of the same magma as the components of the greenstone. Vogt, in describing similar nickel deposits in Norway, speaks af the sulphide as rock-forming mineral, and believes them to have assumed their present form at the time of solidification of the rocks containing them. He calls such rocks, rich in pyrrhotite, pyrrhotite-norites, and regards the ores to be the most basic rock constituent. He considers that the relation of the pyrrhotite-norite to the greenstone is similar to that which the basic borders on granite-stock hold to the granite ; both, he believes, were formed by the differentiation of a once homogeneous magma. Sandberger separated the dark silicates of a great many rocks, and, by operating on quantities of 30 grams, proved them to contain Cu, Ni, Co, Pb, Sn, Sb, As, Bi, and Ag, and considered them also to act as bases. Whether Vogt's opinion, that the pyrrhotite-norite of Norway is related to the greenstone in the same way as the basic borders on granite stock is to the granite, and that the Norway deposits took their present form on solidification, applies equally well to Canadian deposits, is doubtful, though what he says of the origin of the Norwegian deposits might be applied to the Canadian deposits in every other respect. Those holding to the whole of Vogt's opinion explain the concentration of the ore at or near the contacts in the following way :—Soret proved that if a solution of common salt or other substance be unequally heated there will be a concentration of the salt, etc., at the point having lowest temperature. This would follow from the law of Osmoses, (the relative degrees of concentration being to one another inversely as the absolute temperature.) Thus in considering the molten magma as a solution in which the pyrrhotite and chalcopyrite were dissolved there would be a concentration at the coolest points, which of course would be the line of contact. We might also take into account the principle of convection currents which would be naturally set up in the mass by the differentiation in temperature of the different parts of the molten magma. These, as they passed along the colder surfaces of the walls inclosing the mass would coat them with the sulphides, which being the earlier and less mobile crystallizations would be the first to crystallize out of any molten magma.

The foregoing would of course not hold were the granites and gneisses which have been found in nearly all cases to bound the greenstone near the deposits, proven to be of younger age than the greenstone. We should then have to explain the deposits as having taken their present form subsequent to the eruption of the greenstones. That the granites and gneisses are younger in many cases at least, is proven by their cutting into the greenstones in the form of stringers or small dykes near the junctions.

Such is found to be the case near the Murray mine and several other localities in the district. The younger age of these granites and gneisses is now admitted by all authorities on the subject, still, some who have admitted it do not seem to have recognized the fact that, this being so, the deposits cannot have been formed along the contacts while the greenstones were still molten, as they intimate. In some cases cracks and cleavage joints in the greenstone are filled with thin seams of mineral matter pointing undoubtedly to aqueous action ; while also the granites and gneisses near the contacts are sometimes found to contain specks of the sulphides. These facts, in conjunction with those pointed out in former parts of the paper, have caused the writer to form the opinion on the formation of the veins which he stated in the third theory. In the writer's opinion, such a theory violates no known laws, and harmonizes more with most of the principles which have been discovered in connection with these deposits, as well as conforming to the general principles laid down as the bases of nearly all vein formations.

MINING IN THE SUDBURY DISTRICT.

The mines of this region consist mainly of large open cuts and enormous so-called stopes, which are worked by what might be said to be a crude form of " underhand stoping." The walls of the mines are so solid that almost no timbering is required. The stringy and distributed nature of the deposits necessitates the cutting away of a large amount of rock material, and in one mine the Canadian Copper Co. are virtually slicing the top off of a large hill in the process of removing the ore.

OTHER NICKEL REGIONS.

Nickel has also been found in the United States, Norway, and New Caledonia, but the New Caledonia and Ontario deposits are the only ones now producing any considerable quantities of the metal. The Norway deposits, which are similar in character to those of Ontario, have produced some nickel in the past, but they are now about worked out. New Caledonia deposits consist of a hydrated silicate of nickel and magnesia called garnerite, after their discoverer. They are bright apple-green in color, and are found at or near the contact of the clay with the inclosing serpentine in a stockwork-like formation, consisting of pockets or small veinlets traversing the mass in all directions. The ore averages about 10 per cent. nickel, after sorting with serpentine as gangue. The deposits are mined in a somewhat primitive fashion, mainly by large quarries, the red clay being first carefully stripped, and then the ore which lies immediately beneath is broken down and sorted by hand into rich and poor qualities. The former contains 8 per cent. or over of nickel, and the latter, which contains 3 to 4 per cent, is thrown aside as worthless.

METALLURGY.

The process in vogue at the works of the C. C. Co. is to send the ore as it is brought from the mine to a structure called a rock-house, where it is sledged the proper size for a 15 x 9 in. Blake, set to about 1¾ inches, with a capacity of two hundred tons per hour to which it is fed. It then passes through a series of trommels, the fines passing a ¾ inch ring, mediums a 1¾ inch ring, and coarse a 4 inch ring. The coarse fall on bumping tables from which the ore and gangue is partially separated by hand-picking. The ore may now either be smelted " green," that is, without roasting, or it goes to the roast heaps, where it burns for from two to six months, thus oxidizing the sulphur, which is reduced in this way from about 24 per cent. or thereabouts to 2½ to 8 per cent. An average sample of the roast ore gave :

Copper	3 25 per cent.
Nickel	2.16 "
Sulphur	8.32 "
Iron	25.61 "

And the rest gangue.

Each heap contains from one thousand to four thousand tons of ore, the average being about two thousand tons, and they burn from two to six months, the time depending on their size. The place selected for the piles is first covered with fine ore distributed evenly over the clay soil, the ground around being well drained to prevent as far as possible the leaching out of the nickel and copper sulphates, then a foundation of cordwood, stamps, etc., is made through which are arranged canals filled with kindling wood communicating to chimneys for the supply of draught. The interstices are then filled up with small wood

and chips, over which is laid the coarsest class of ore, then the mediums, next a layer of rotten wood or chips, then a layer of regular raggings and over all a layer of fines and flue dust. When sufficient of the sulphur is oxidized they are blasted up and the ore is sent to the smelter.

There are two smelters now at Copper Cliff with thirteen furnaces in all. The furnaces are water-jacketed and belong to the Herreshoff type, each having a capacity of a hundred and twenty-five tons per twenty-four hours. They are each supplied with a circular well, mounted on wheels which rest on a track so that the well may be easily pulled away in case of a freeze up or when the furnace is to be tapped out. The well serves as a settling chamber in which the slag and matte separates, and it also prevents the formation of "salamanders," which Peters says are the terror of copper smelters. The slag runs out from an opening near the top and the matte is drawn off from a lower opening at certain intervals, the duration of which depend on the ore being smelted. Every two furnaces are supplied with a flue dust chamber leading to a tall stack. These chambers are for the purpose of saving the flue dust, which carries about 7 per cent. metal. An analysis of a typical sample gave:

Cu..... 4.25 per cent. Ni ..... 3.37 per cent.

The ore is smelted with seven to eight tons of ore to one ton of coke; it is very seldom that any flux is required as the ore contains all the ingredients of an easily fusible and fluid slag. But when the charge is very high in iron or other bases, a little of the most acid greenstone is used. This is one of the excellent features of the Sudbury ores and one in which they surpass those from New Caledonia, as there is very seldom any room taken up in the furnace, or any heat lost in the smelting of extraneous fluxes, while no expense is incurred in the handling of such materials. The slag is a mono-silicate of iron and contains about 40 per cent. iron and 0.25 to 0.2 per cent. of nickel and copper which is present in the form of specks of matte and not in the form of oxides as was formerly supposed. The slag either runs into troughs and is carried away on the dump by the waste water of the furnace jackets or is caught in pots and dumped into a ravine in the process of making a foundation for the extension of the smelter.

Low-grade matte, or that produced by the smelting of "green ore," is run into pots and spilled on a dump while still molten. When cool it is broken up and sent to the roast heaps, and after oxidation is re-smelted and issues from the furnace as "standard matte." The former carries from 8 to 15 per cent. metal while the latter carries from 25 to 42 per cent. An analysis of a typical sample of the former gave—

Cu..... 7.45 per cent. Ni..... 6.01 per cent.

and a sample of the latter gave—

Cu.....20.35 per cent. Ni..... 16.48 per cent.

The standard matte is caught in pots which are dumped when cool, the matte being then broken up and sent to the smelting works of the Orford Co., situated about 500 yards south of the Copper Cliff mine. Here the matte is first pulverized in a Krupp ball mill of two hundred tons capacity per 24 hours, and is then fed to three straight line roasters whose dimensions are about 4 ft. high by about 150 ft. long by 25 ft. wide. These furnaces are continuous, the material inside being pushed along by a series of rakes fastened to an endless chain. The roasted material contains from 2½ to 3 per cent. sulphur, and is hoisted up by a bucket elevator to the charging floor of two brick cupola furnaces whose dimensions are 8½ ft. to charging floor and 12 by 7 ft. on a horizontal section, each being supplied with three charging doors.

The matte which issues from these furnaces contains from 65 to 80 per cent. metal. An analysis of a typical sample gave:

Cu..... 39.75 per cent. Ni..... 31.26 per cent.

The slag contains from 2.5 per cent. to 3 5 per cent. of metal and is resmelted. The matte is shipped to the Orford Copper Co. at Constable's Hook, New Jersey, where it is refined by the alkaline sulphide process, which depends on the fact that if a fairly rich nickel-copper matte be smelted with sulphate of soda and coal the sulphides of copper and iron unite with the sulphide of soda produced in the process to form a very fusible mass, while the nickel sulphide known as "bottoms," which is of greater specific gravity, sinks to the bottom fairly free from the other two metals. Upon cooling, there is a distinct line of separation visible, and the nickel sulphide in a yellowish white mass is readily removed from the dark irridescent iron-copper matte.

The Canadian Copper Co. also have three converters which they sometimes use in the producing of 80 per cent matte, an analysis of which is given in a former part of the paper. During last summer they shipped two hundred tons of this matte to Cleveland. Ohio, to be refined at their experimental plant there. The converters are of the Manhes type and are supplied with hydraulic power. Their dimensions are: length, 7 ft. 3 in., diameter 5 ft. 8 in., number of tuyeres 12 diameter of tuyeres ¾ in. They have a capacity when newly lined of 1½ tons, with old lining 3 tons. The blowing engine which supplies them with draught is of the double cylinder simple slide valve type and maintains a pressure of six pounds of air per square inch when blowing one converter. The lining of the converter is the principal point on which the economic success of the process depends. It not only protects the furnace but it supplies silica for the formation of the silicate of iron slag. This has been found to be the only successful way of supplying silica to the charge. If supplied with the charge it simply floats on top, and if let in at the bottom it rises to the top without performing its function. The lining is composed of clay and silica the clay giving to it plasticity, and protection to the furnace. An analysis of a sample of converter slag gave:

Fe O ..... 67.6 per cent. Cu..... 1.2 per cent.
Si O_2..... 27.5 " Ni..... 1.4 "
S..... 0.5 per cent.

The converters are first heated by burning wood in them, and then the charge which has been melted in a small melting furnace on the upper floor, is run in by troughs, the converters are swung into place and the blast started with low pressure at first, then full pressure for about forty to fifty minutes. The end of the reaction is told by the temperature of the flame and by the flakes of slag blown out of the converter, which as the end is approached become large and frothy. The blast is then turned off and the metal is allowed to settle for a few minutes, when the converter is revolved, and after the slag is spilled off the matte is turned into molds.

NICKEL IN THE ARTS.

Nickel has a specific gravity of 8.3 to 8.9 per cent., an atomic weight of 58.6 and an atomic volume of 6.6. Its melting point is about the same as that of steel, depending on the amount of carbon present. Specific heat is about 0.108 to 0.110. Nickel is slightly stronger than pure iron, is harder and withstands oxidation by moisture and steam much better. When heated to redness no perceptible oxidation is noticeable: it is slowly soluble in hydrochloric and sulphuric acids, and is readily soluble in dilute but remains passive in concentrated nitric acid. Nickel is used in plating and as an alloy in the manufacture of German silver. When alloyed with iron and steel it forms a remarkable series of metals. It has the greatest range of adaptability of any alloy and so has met with a very great amount of popular approval, and its use is rapidly becoming as much recognized as that of carbon or manganese steel. On the addition of nickel to iron or steel its greatest influence is shown in the limit of proportionality while the ultimate strength and to a high degree the elastic limit

ncreased. An alloy of 8 per cent. of nickel with pure iron has 3.8 imes the elastic strength of pure iron. Nickel is now being used for a great many purposes, among which might be mentioned rails for railroads, armour for armour-clads, rifles and small arms, a specification for which from the United States government stated that 4.5 per cent. of nickel must be present in the steel. Nickel steel is also used in the manufacture of rivets, tubing, and bicycle parts, also in tool steels and a number of machine parts for which its peculiar strength, ductility and incorrodibility gives to it especial fitness.

All nickel steel alloys are remarkably homogeneous, easily workable and susceptible to high polish. Some nickel alloys have been used recently for electrical purposes on account of their peculiar property of losing magnetism when heated and regaining it when cooled, and there now promises to be a great demand for nickel in the future, for the new Edison storage battery alone, while all of the above uses point to a demand which will tax to the utmost the vast resources of the mines of Ontario. This is well shown by the price of nickel now being from 50 to 60 cts. a pound on an open market, while a few years ago it was less than half of this on a restricted market.

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Notes on the Geology and a Few Ore Deposits of South Eastern British Columbia.

By C. V. Corless, McGill.

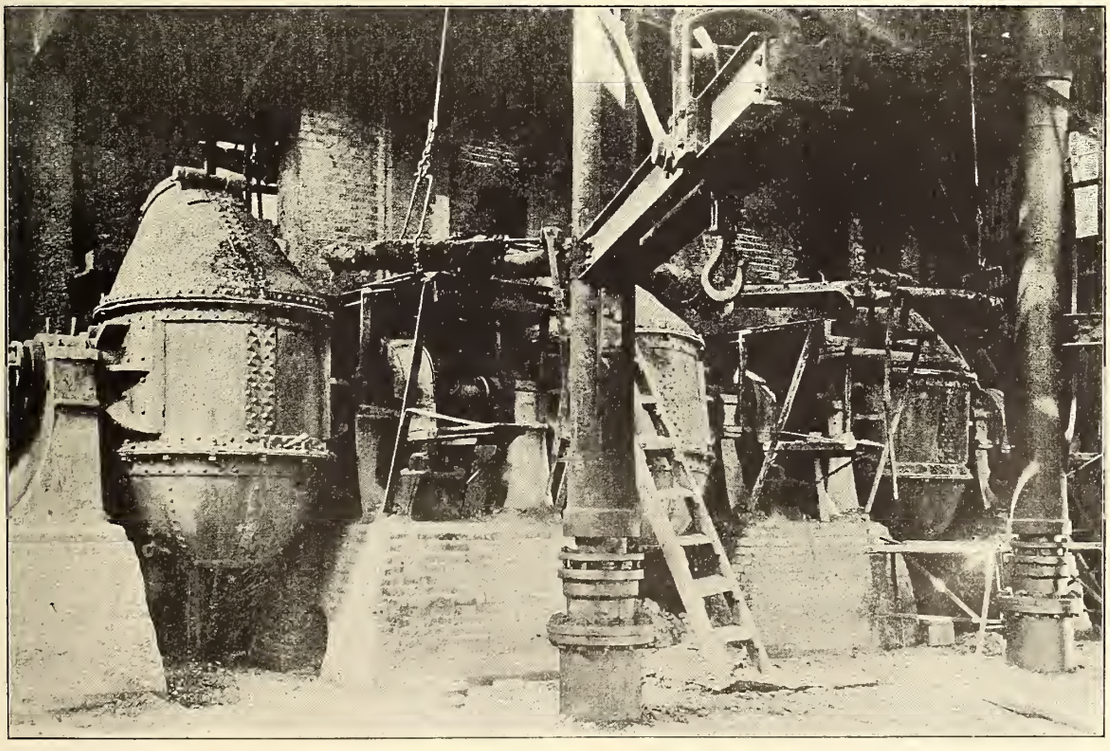
PREFACE.

The underlying idea of the following notes, which at first sight appear to be perfectly disconnected, is, that the ore bodies treated of form part of a related group, suggesting that, probably, veins formed in a similar way over a still wider area may be similarly related, owing to the derivation of their metals, mainly, if not altogether, from the deeper part of the zone of rock fracture, and from igneous masses intruding into this zone. Should veins so formed be found generally thus related, particularly where, as in the present instance, the surface geological conditions are very diverse, it would furnish strong evidence in favor of considerable depth of origin of the metals carried by mineralizing solutions.

While the data collected are much too insufficient to prove the truth of any hypothesis, it is felt that such evidence as they furnish at least points towards this explanation.

To complete the present notes, some special deposits of Ainsworth and Goat River mining divisions should be described, but as no mine was visited in either, the former is passed over by a few general remarks, while the latter is not mentioned.

The notes on the ore deposits were made during the mining tour of the McGill Summer School for 1901. The notes on the geology were gleaned from the various sources given, and while they are a mere repetition of facts generally known or easily obtainable, the rude out-



Converters at East Smelter, Copper Cliff, Ontario.

line of the geology of the district was felt to be of too great importance in relation to the ore deposits to permit of its omission.

The provincial reports for 1897, 1899, and 1900 have been freely consulted for confirmation of observations and for additional details in the case of certain deposits. Also current mining magazines have been appealed to, where articles were available, for additional confirmation and for an occasional detail.

While considerable care has been exercised in compiling the notes, nevertheless, that errors should creep in, in so hasty a visit to each mine, seems unavoidable. It is hoped, however, that such will prove to be few.

Thanks are due to the several mine managers and superintendents for their great courtesy and kindness in granting permission to the class to examine the several deposits as well as the surface plants, and for valuable information, which was very freely given; they are due also to Dr. Porter, under whose guidance the mines were visited, and to Dr. Adams for many valuable suggestions, and for kindly checking the notes on certain of the mines.

Professor Kemp's work on the "Ore Deposits of the United States and Canada" was freely consulted in drawing comparisons between this group and certain others in the Rocky Mountain region.

C. V. CORLESS.

SUMMARY.

I. Introduction and Description of District.
II. General Geography of the District.
III. General Geology of the District—
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INTRODUCTION.

In that part of the basin of the Columbia River which lies between the forty-ninth parallel of latitude and the Canadian Pacific Railway, important developments in mining have been made in recent years. Here have been discovered a number of remarkable ore deposits, the development of which is making south eastern British Columbia famous as a mining district. To the west, in the drainage area of the Kettle river, are found the deposits of the "Boundary Country," now attracting so much attention. Next east lies Trail, with Rossland as a centre, these two districts being remarkable for their large deposits of low-grade auriferous copper ore. Eastward again, is Nelson district, with its well-known free-milling gold and silver-bearing deposits, while to the north and east are found the argentiferous galena ores of the Slocan, Ainsworth, and Fort Steele mining divisions. Lying in the last mentioned mining division, and of very great importance to the development of the smelting propositions, are the practically inexhaustible Crow's Nest coal seams.

It is the purpose of the present paper to present some brief notes on the geology and a few of the ore deposits of the region roughly outlined above.

GENERAL GEOGRAPHY.

This region is very mountainous and rugged. The Upper Columbia and its tributary, the Kootenay, into which flows the Slocan, have their courses largely formed by long and relatively narrow lakes, which, being navigable, have greatly aided in the development of the mines in this otherwise difficultly accessible district. The Kootenay drains the Kootenay and Upper Kootenay lakes; the Slocan rises in Slocan lake, lying to the west; the Columbia widens out into the Upper and Lower Arrow lakes, west of this; while, to the west again, the Kettle river, a western tributary of the Columbia, receives the waters of Christina lake.

All these, as shown by the accompanying sketch map, lie mainly in north and south valleys, and receive the discharge of the smaller streams from the generally precipitous slopes lying to the east and west. Along these creeks the veins have generally been located. Grand Forks mining division surrounds Christina lake. Trail and Nelson embrace the west and the east bank, respectively, of the Columbia as it leaves Canada, Nelson occupying the basin of the Salmon river and extending north-eastward to Kootenay lake. Slocan extends from east of the Arrow lakes beyond Slocan lake. Ainsworth surrounds Upper Kootenay lake and the north end of Kootenay lake, while Fort Steele, occupying the south-east corner of British Columbia, embraces both banks of the Kootenay as it enters Montana.

GENERAL GEOLOGY.

Of the geology of the district outlined, comparatively little is known. The following brief notes have been gleaned mainly from papers and reports by Mr. Carlyle, Mr. McConnell, Mr. Brock and Dr. G. M. Dawson.

The principal series of sedimentary rocks that have been recognized are as follows:—(See sketch-map.)

1. The Shuswap series, consisting of mica schists, gneisses, quartzites, and marbles, of Archean age. These rocks occur typically developed in a narrow strip bordering Kootenay lake, north of the west arm. They are also found north of Slocan lake.

2. The Nisconlith series, consisting of dark shaly slates, with quartzites, limestones, and dolomites, referred to the Cambrian. It is found bordering the Shuswap, parallel to Kootenay lake, but is more largely developed in the Nelson district. Here a band several miles in width extends from a short distance east of the town of Nelson to the international boundary, widening to fifteen or twenty miles along the Pend d'Oreille, an eastern tributary of the Columbia.

3. The Selkirk series, consisting of schists, quartzites, conglomerates, dolomites, and green eruptive rocks. This series borders the Nisconlith west of Kootenay lake. It is also found on the divide between Kootenay lake and Salmon river, a tributary of the Pend d'Oreille from the north.

4. The Upper Selkirk series of quartz and mica schists. These rocks, overlying the Selkirk series, are found on Summit creek, extending eastward to Kootenay lake.

5. The Slocan series, of dark shales and impure slates and limestones, with tuffs and ash rocks. These rocks are found around the north end of Slocan lake and eastward, with a band extending southward between the Selkirk beds and a great granite mass to the southwest.

6. The Quartzite series, of the Cambrian. East of Kootenay Lake for some distance the formations have not been so carefully made out. Of the region about St. Mary's river, a western tributary of the Kootenay, Mr. Carlyle in the Provincial Report of 1897, says:—

"The mountains in this part of East Kootenay belong to the Purcell Range. . . . Geologically these mountains comprise well stratified quartzite slates, shales and siliceous limestones overlying, apparently, schists and gneisses, and broken through by areas of erup-

tive rock, from which intrusive sheets lie as if interbedded with sedimentary rocks."

This region about St. Mary's river, together with a belt along the east bank of the Upper Kootenay river, extending to the international boundary and beyond, is of the Quartzite series.

7. The Limestone series of the Devonian and Carboniferous. This is found bordering the Quartzite, extending eastward to the Elk river, an eastern tributary of the Upper Kootenay, and southward beyond the forty-ninth parallel. Other narrower bands of limestone are exposed in the Cretaceous to the east.

8. One or more series of the Cretaceous containing the remarkable Crow's Nest coal seams.

Varied and complex as are the sedimentary rocks described, through the intense folding and denudation of the mountain masses, they have been made vastly more complex by being faulted, dyked and metamorphosed by numberless intrusions of igneous rocks. Doubtless, to this fact is due, in great measure, the vast mineral wealth of this part of British Columbia.

These igneous rocks are of several different groups, including the following :—

1. The Columbia volcanics, of porphyrites, monzonites, gabbros, breccias, tuffs, agglomerates and fine-grained ash-rocks. These rocks occur about Rossland, also across the Columbia to the Salmon River and northward to the Kootenay River and the West Arm of Kootenay Lake. Probably, too, the volcanics of the Boundary belong to this group.

2. Gray granite, probably the commonest rock in the region described. The granite contains both biotite and hornblende and is usually gray in color. This is found in a large mass southwest of Slocan lake and bordering the Lower Arrow lake. It also occurs along both banks of the Kootenay river from Kootenay lake to its confluence with the Columbia, and following the Columbia southward. It is found also in small areas throughout the entire West Kootenay. It is younger than the other rocks of the district, so far mentioned. It is the granite seen so abundantly at the town of Nelson.

3. The younger eruptives, described by Mr. Brock and grouped by him into—(*a*) the " white dykes " and (*b*) the " black dykes."*

(*a*) The " white dykes," of greatly varying thickness and ranging in composition from rhyolites to diorite porphyries. They are generally light in color, the acid types prevailing, though in some places darker types are met with. The ore deposits appear to be generally closely related to these. Probably the hot solfataric waters following the close of the period of volcanic activity that was accompanied by the intrusion of these dykes, constituted one of the principal factors in the genesis of the ore bodies.

(*b*) The " black dykes " of which Mr. Brock in the paper already alluded to, says :—

" Younger than this system of dykes (the ' white dykes ') and the ore bodies, and consequently cutting these, are the ' black dykes,' a group of lamprophyric and basaltic dykes."

ORE DEPOSITS.

Classification.—In this region, the ore bodies to be described may be roughly grouped into three classes. The prevailing type of ore of the Slocan, Ainsworth and Fort Steele mining divisions, to the northeast, is argentiferous galena ; that of Trail and Grand Forks, to the southwest, is auriferous, copper-bearing pyrrhotite ; while Nelson, which lies geographically between these, generally produces ores which appear to be mineralogically transitional.

A. *Silver-Lead Deposits.*—In Slocan mining division Mr. Carlyle recognized four classes of veins :—†

1. Those with argentiferous galena, blende and some tetrahedrite, in a gangue of quartz and siderite. These are the most numerous and important veins in the district.

2. Veins of argentiferous tetrahedrite, jamesonite and silver minerals in quartz gangue, but not numerous.

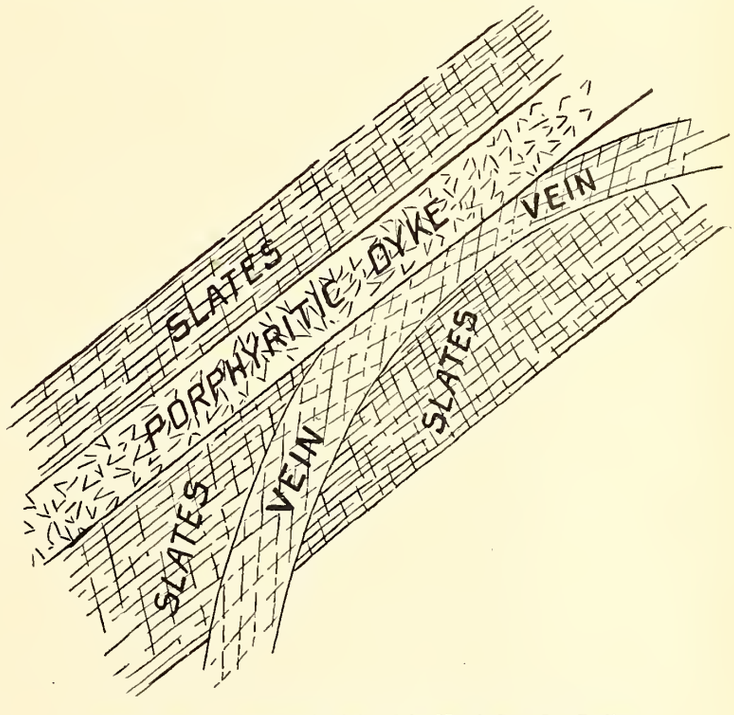
3. Veins carrying argentite with native silver and gold, in quartz gangue.

4. Gold quartz veins, in granite.

In the Ainsworth mining division, the gangue is commonly quartz and calcite and the ores are argentiferous galena, with some blende and pyrite, or silver minerals with some tetrahedrite and other sulphides.

In Fort Steele division the best known veins are of silver-bearing galena in a gangue of calcite and quartz.

Example 1.—The Slocan Star. This vein is situated in Star Mountain at Sandon in the Slocan. It will serve as a type of the large group of veins at Sandon. It appears to be a true fissure vein which, owing to its insoluble walls, cannot have been much enlarged by replacement. The strike is east and west and the dip is south into the mountain at 40° to 60°. The country rock is of slates of the Slocan series. The ore is mainly galena with considerable zinc blende and some tetrahedrite. The oxidized zone extends downward but a few feet except where there are special water channels. The gangue is mainly of quartz, siderite and calcite with a little barite. The vein, so far as exploited, has a width of four to twenty-seven feet, rising to the grass-roots. Values are maintained with depth, but are not markedly increasing. Concentrates and picked ore run from 75 to 150 ounces in silver and 35 per cent. lead. Small picked specimens of tetrahedrite are said to run several thousand ounces in silver. The blende, which is separated from the galena as far as possible in the concentration



Sketch showing suggested origin of the North Star Ore Bodies.

carries high values in silver. The richest part of the vein is generally on the side of the hanging-wall. The hanging-wall is formed for a short distance by a porphyritic dyke from which the vein curves as shown roughly in the sketch. There is no noticeable change in values at the contact.

A large horse 30 feet thick and 130 feet long divides the vein at one point for 300 feet in depth. Values showed considerable increase at the union of the two divisions of the vein at either end of this horse. This ore body shows no disturbance of any account through faulting.

*Paper by Mr. Brock in the Journal of the Can. Min. Inst., 1897.

†Bulletin III, Bureau of Mines, Victoria, B.C., 1897.

The ore body is opened up by adits cross-cutting the country slates, with levels on the strike of the vein. Owing to the increase with depth in the length of the adits, a shaft on the dip is being sunk from the fifth level.

A well-equipped concentrating plant, with an abundant water-supply, is in operation.

Example 2.—The St. Eugene. This vein or group of veins is situated near Moyie lake, a few miles from Cranbrook, in Fort Steele mining division.

In 1900, the Fort Steele mining division made a greater increase in production than any other single mining division in Britlsh Columbia, the value of the mineral output having risen to almost three million dollars, placing this district in total output second only to Nanaimo division. The metalliferous mines produced, in 1900, more than $2,200,000, nearly the whole of which was obtained from the St. Eugene, North Star, and Sullivan mines, in the order named. In the same year, the St. Eugene was the largest single lead producer in British Columbia, its output being nearly as great as the combined production of the mines of the entire Slocan mining division.

The St. Eugene mine includes three or more sets of workings, all on the same vein. This vein occupies a fissure or group of fissures which extend from the summit of the mountain in which it occurs down to the level of Moyie lake, a vertical distance of about 1900 feet The whole vein appears to be mineralized to some extent, but two portions between the principal workings seem at present unproductive.

The upper, or St. Eugene workings extend from the surface to the 400-foot level ; from the 400-foot level to the 800-foot level is unproductive.

The middle, or Moyie, workings extend from the 800-foot level to the 1000-foot level ; from the 1000 foot level to the 1500-foot level is unproductive.

The lower, or lake-shore workings extend from the 1500-foot level to the 1800-foot level, which is about 100 feet above the surface of the lake.

The ore body fills two or more parallel fissures with diagonal gashes between. The width averages ten feet, reaching thirty feet in places. The walls, generally clearly defined, are of the country slates, which lie here in nearly horizontal position. The vein is somewhat difficult to follow next the walls, since it branches out between the strata, leaving tabular pieces of the slates projecting into the ore body. As a result, horses are frequent. At one point one of these tabular pieces of slate projects entirely across the vein. The gangue is mainly the slates of the walls, with some quartz. There is some zinc blende and a little pyrite. The silver values are slightly less in the lower workings than in the upper, being about two-thirds of an ounce of silver to the per cent. of lead in the St. Eugene, or upper workings, and about one-half of an ounce of silver to the per cent. of lead in the lower.

The mine is equipped with a concentrating plant of about 400 tons capacity daily, the rate of concentration being about 4½ : 1, producing a concentrate running 65 to 70 per cent. lead.

This ore body is opened up by a series of tunnels along the principal vein, with cross-cuts to the parallel connected vein, the tunnels of each set of workings being connected by raises. The upper workings are connected with the concentrator by an aerial tramway ; the middle, by gravity tram to the 1500 level, thence by mule-tram to the mill ; the mule-team also connects the lower workings with the mill.

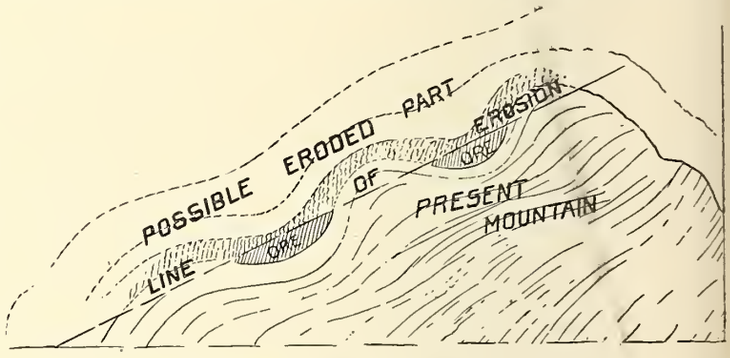
Example 3.—The North Star. This unique ore deposit, situated abont one mile from Kimberley on Mark creek, is reached by the recently constructed branch of the Canadian Pacific Railway from Cranbrook.

The ore body, or rather bodies, are of remarkable form. They occupy two or more approximately parallel, basin-like depressions running diagonally up the mountain side, with clearly-defined limits. These depressions are filled with almost pure galena with associated oxidized ores. So pure is this ore that with only ten to fifteen per cent. rejected as waste, values run about 25 to 30 ounces in silver and 50 to 55 per cent. lead, with only 3 per cent. zinc blende.

The general direction of the ore-bodies is north and south. One reaches a length of 180 feet with 40 feet depth. A cross-cut 70 feet to the west from this, reaches a parallel ore-body of 400 feet length, 70 feet width and 50 feet depth. Both bodies rise to the surface, being merely covered over with drift, which may be considered as the hanging wall—a fact that necessitates very careful timbering.

The country rock has been called metamorphosed felspathic sandstone, by Dr. Dawson. The contact of the ore body with the country rock is generally sharp and well defined. Though the walls generally show no mineralization, in some places they are pyritized, while here and there they are impregnated for a few inches with galena.

Though no dykes have been met with, the ore bodies are possibly related to igneous intrusions, as is apparently indicated by the metamorphosis of the sandstone. This, however, may be due merely to the intense folding which gave rise to the mountain masses. The peculiar form of the ore bodies suggests a folded "blanket vein," from which the summits of the anticlinals have been eroded. Whether



Sketch showing suggested origin of the North Star Ore Bodies.

these peculiar bodies of ore will ultimately be found to be connected with fissures along which the mineralized solutions travelled, seems doubtful. Possibly the usual fissure or fissures were some distance away, and the mineral-bearing solutions followed the strata at this point, being confined by some igneous intrusion now eroded away. The true origin of this remarkable deposit would probably be revealed by a detailed study of the local geological conditions.

GENERAL NOTES ON SILVER-LEAD DEPOSITS.

The above are typical of a large number of silver-lead veins in these districts. These occur mainly in sedimentary rocks and in close relation to igneous intrusions.

A comparison of twenty-four important silver-lead deposits of the Rocky Mountain region, chosen at random, from New Mexico to British Columbia, showed that twenty-one, or 87½ per cent., occur in sedimentary rocks, and of these fifteen, or over 62 per cent., occur in limestones, the remaining six being in quartzites and slates, while, almost without exception, all occur in contact with, or in close proximity to, igneous intrusions. The galena of these deposits is uniformly associated with zinc blende and a gangue, generally of quartz and calcite with barite or siderite at times. This indicates, apparently, a certain uniformity in the minerals associated in the mineralizing solutions to which these veins owe their genesis, and this fact must indicate, in turn, a general uniformity in the geological conditions giving rise to the solutions.

B. *Gold-bearing Copper Deposits.*—1. *Of the Boundary.*—Probably no ore bodies in British Columbia are attracting more attention at present than the enormous low grade, auriferous, copper-bearing deposits of the so-called "boundary country."

Local Geology.—The following brief notes on the local geology are taken from Mr. Carlyle's provincial report for 1897 :

"The preponderant rock formation noticed from the north fork of the Main Kettle river was seen to be very highly metamorphosed Archean sedimentaries or gneisses, schists, quartzites, slates, and perhaps some crystalline limestones, in which are found almost all the gold-bearing veins and veins of high grade silver-gold ore.

Overlying these rocks are seen the fragmentary areas of highly altered limestone, as this region has been subjected to much eruptive action along lines of fracture and eruption running northerly and southerly; and all the formations are traversed by dykes of various eruptives and overlain in part by areas of effusive rock, mostly light to dark green, partly crystalline, fine-grained felspathic rock, the miners' "diorite," which is a very important member, as in this case are all the large zones, impregnated with gold, chalcopyrite, hematite, and sometimes pyrrhotite and iron pyrites. Many of these deposits lie in contact with, or in close proximity to, very crystalline limestones, which generally show a nearly perpendicular plane of contact with the general strike of north and south."

This indicates the much disturbed nature of the district.

The Ore Bodies.—In this district two well-known ore bodies will be described.

Example 4.—The Mother Lode. This deposit is situated about two and a half miles from Greenwood, with which it is connected by a railway spur. The ore body is a zone of fine-grained, greenish volcanic rock, impregnated with a small percentage of chalcopyrite, some iron pyrites, and, in parts, very fine-grained magnetite, with a variety of other, mainly secondary, minerals. The lode can be traced on the surface for 1800 to 2000 feet, with a width varying from 80 to 160 feet, while below, the mineralized zone widens to 200 feet.

The form of the ore body is somewhat crescent. The strike is, roughly, north and south, and the dip, eastward, with the strata at 55 to 65 degrees.

On the surface, 1,100 feet north of the shaft, the vein is cut off by a so-called lime dyke, 500 to 600 feet thick, dipping southward, so that on the 200-ft. level the ore body is cut by it 800 ft. north of the vertical shaft. This so-called lime dyke, really a limestone bed of the country rock, sweeps round to the west, forming the foot-wall. The hanging wall is a greenish rock, said to be a diabase. Thus the mineralized zone lies between the limestone on the west and the fine-grained, massive, eruptive rock on the east.

On the foot-wall side, the transition from barren rock to pay ore is gradual, while on the hanging-wall side it is fairly abrupt. The chemical composition of the hanging-wall and that of the mineralized rock near to it, omitting the pyrites, are the same. There is, besides, in places, some soft gangue, beyond which the wall-rock is not broken. These facts point, possibly, to the existence of a fault here.

Porphyry dykes occur, which, together with the more or less fissured zone accompanying the apparent fault, must have formed a ready means of ingress for mineralizing solutions while the vein was forming, One of these dykes, with a thickness of 16 feet and a dip of 30 degrees. cuts the vein at right angles.

The ores have been grouped roughly, from a metallurgical point of view, into three classes. These are:—

(1) *Calcite Ores*, consisting of calcite, bearing copper and iron sulphides, either massive or scattered, frequently with quartz, garnets, serpentine, or all three, and occasionally with a little zinc blende.

(3) Magnetite ores, consisting of a hard, fine-grained magnetite with quartz and chalcopyrite, but containing very little iron pyrites.

All three classes carry gold, and the calcite and silicate varieties carry one or two ounces of silver as well.

In addition to these three classes, there has been found on the foot-wall side on the 200-ft. level, a little galena and zinc blende in a gangue of calcite. This seems to be a curious incidental confirmation of the tendency above alluded to, viz., of limestone to precipitate and segregate galena out of mineralizing solutions.

The following note on the occurrence of gold and the analyses of typical specimens of the three classes of ore are taken from the Canadian Supplement of the Engineering and Mining Journal of New York, May 18, 1901 :—

	Calcite Variety.	Silicate Variety.	Magnetite Variety.
Silica	20.10	44.23	27.33
Iron Oxides	12.00	16.83	51.12
Alumina	1.31	7.46	.....
Ca. and Mg. Oxides	34.00	16.03	10.26

An inspection of these figures shows how admirably the ore is adapted for self-fluxing by mixing the three classes in suitable proportions. Taken as a whole they are too basic for self-fluxing. A curious and probably inexplicable fact has been observed regarding the gold values. As a rule gold increases as copper increases, but not in the same ratio. But the presence of iron pyrites seems necessary for carrying gold, for samples of chalcopyrite with no iron pyrites yield little or no gold. As an illustration, a sample assayed 15 per cent. copper, yielding $16 in gold, while a very rich piece of chalcopyrite with no iron pyrites assayed 28 per cent. copper and only $1.50 gold.

Gold values are increasing slightly with depth.

Another peculiar feature in this body of ore is the occurrence of a body of magnetite, rich in copper, extending downward from the 300 foot level and cutting the vein diagonally.

The mineralized zone on the surface is much decomposed and copper-stained, much of the surface being converted into gossan.

The surface quarries yield ore with about 1¾ per cent. copper, while the levels below run from about 2 to 5 per cent. copper and $2 to $4 in gold. The difference is due probably to leaching.

A considerable variety of minerals occur, among which are calcite, quartz, epidote, garnets, actinolite, magnetite, hematite, pyrite, chalcopyrite, azurite, malachite, galena and zinc blende.

This ore body is opened up by a crosscut tunnel through the limestone wall and by a vertical shaft with levels on the strike, from which raises are made to the surface. The self-fluxing nature of the ore, and the cheap method of mining adopted, viz., the "mill-hole" method, with quarries where the raises meet the surface, have brought a large percentage of this ore-body within the pay limit.

Example 5.—Knob Hill and Old Ironsides. These two mines, together with some adjoining claims, appear to be on the same vast ore body, the exact limits of which are not very clearly known. This body of ore is situated at Phoenix, about three miles from Greenwood, near the summit of the divide between the watersheds of Boundary creek and Fourth of July creek. The strike of the vein is north and south and the dip eastward at 50 degrees. It is thus briefly described in the Provincial Report for 1899:—

"This ore body may be best described as a huge mineralized zone of fine-grained eruptive rock, highly altered, and occurring near a contact with limestone. Through this rock are disseminated yellow copper sulphides, magnetite and magnetic iron pyrites, with small stringers of calcite, while, occasionally, the iron sulphides and oxides become massive."

The vein is of immense size, having been traced on the surface for over a mile in length and for 300 feet or more in width. Below ground a drift was run at one point 400 feet from the foot-wall, across the vein, without reaching the hanging wall. Its width appears to be about 200 feet perpendicular to the dip, but is rather uncertain. Exploitation with the diamond drill has shown that the ore continues at over 1,000 feet of depth. As many thousands of feet of sinking, raising, drifting and cross-cutting have been done, the body of ore may be considered well proven. The ore in this vast body is thus seen to be practically inexhaustible and it has been shown that the grade of ore improves with depth. The deposit is generally very low grade and very uniform, carrying values roughly similar to those at the Mother Lode.

The foot-wall seems mainly silicified volcanic breccia, the hanging-wall being probably a limestone breccia. The foot-wall is generally fairly clearly defined by the presence of three or four feet of selvage, indicating movement. As at the Mother Lode, the limestone wall is more indefinite. Dykes occur but are not frequent. The gangue is mainly calcite, with quartz, hematite and magnetite, epidote, etc. As at the Mother Lode, the ore is self-fluxing. The oxidized zone is generally about 50 feet, but in one instance follows a water-course for 300 feet in depth.

The similarity of this deposit and the Mother Lode in respect to strike, dip, mineralization and contacts is very marked. Probably closer study of the geological conditions in this locality will reveal still closer relationships between these two kindred deposits. Both these veins seem to have been formed by replacement, the highway for the mineralizing solutions having probably been formed by eruptive disturbances of the strata with resulting dykes and fissures.

In their formation along the contact of limestone with igneous rock, these two ore bodies resemble a number of other important veins in the well-known Warren and Globe Districts, Arizona.

2. *Of Rossland District.*—Probably the prosperity of mining in British Columbia during the past few years has been more influenced by the prosperity of Rossland than by that of any other mining camp in the province. Certainly foreign as well as Canadian capitalists have, for nearly a decade, shown great faith in Rossland Camp, with the result that we now have here a flourishing city whose sole industry is mining.

Local Geology.—The following notes on the geology of the district are gathered from various sources, but mainly from Mr. McConnell's report to the Geological Survey for 1896 :—(See map).

In the district about Rossland, rocks of igneous origin are markedly predominant. The principal rocks occurring are :—

(1) Granites. The granites are gray, and of the same age as those before described as typically developed about Nelson. Here they follow the east bank of the Columbia to a point near but below the mouth of Bear creek (see map). The south eastern edge crosses the Columbia and follows Lookout Mountain ridge for some distance. West of the Columbia the granites occur in a band roughly two miles wide, with an expansion to the west partly surrounding the Kootenay —Columbia mountain. There are, besides, some isolated bosses of granite elsewhere in the district, for example, on the north-west slope of Deer Park mountain.

(2) Gabbros and related rocks. At the central part of the district is a mass of dark, fine-grained rock, with a width of one to one and a half miles north and south, and a length of four to five miles east and west. The rock of this area is of three main types :—

(a) Monzonite, the country rock of the principal mines, Centre Star, eastern part of the Le Roi, War Eagle, etc. This rock is composed mainly of plagioclase and orthoclase feldspars, with augite, and is of a dark greenish-gray color, tough and generally fine-grained. It is transitional between the syenite on the west and the gabbro on the east.

(b) Eastward the monzonite shades into gabbro.

(c) To the west of the above group of mines, near the Josie, syenite occurs. All three are merely differentiations of the same molten magma.

This group of rocks extends from Deer Park mountain to Lookout mountain. The limits are more exactly shown on the accompanying map.

(3) Porphyrites, tuffs, agglomerates, etc. A section made radially from the above central mass "shows a bordering zone of brecciated porphyrites and diabases of varying width, but seldom exceeding a mile, beyond which comes an alternating series of porphyrites, tuffs, and slates, while, still farther away, agglomerates, associated in places with fossiliferous limestone, make their appearance." * The fossils are said to be probably of carboniferous age.

Slates and tuffs, with porphyrites, are found on Kootenay-Columbia mountain, and on Lake and Bald mountains to the south, while these rocks, together with agglomerates, occur on Granite, Spokane, Grouse, and Lookout mountains, the main mass of Sophia mountain being composed of agglomerate alone.

(4) A peculiar patch of conglomerate, of probably tertiary age, occurs on the southern slope of Lake mountain. This is evidently an erosion remnant.

From the roughly concentric arrangement of these rocks and their gradation outward from holocrystalline monzonites, gabbros, etc., through semi-crystalline porphyrites, to volcanic ash rocks and fragments, lying in bedded position, sloping upward to the central mass, it is inferred that Rossland is located on the site of an ancient volcano now much eroded, in this respect resembling Cripple creek.

(5) Dykes. The entire district is much cut up by dykes varying from light acid, to dark basic varieties of rock, and from microcrystalline to granitic texture. These are due to later upwellings of the molten magma, fissuring the original lavas after consolidation, and filling the fissures.

Example 6.—Rossland Ore Bodies. As might be expected in such a region, there is everywhere evidence, in this district, of dynamic as well as eruptive disturbances, shown in numerous fissures, faults and parallel fissures or shear zones. These shear zones have formed a most favorable means of ingress for mineralizing solutions especially where, as here, dykes exist to direct and concentrate the currents. As the fires of the ancient volcano waned gaseous exhalations were abundant and the underground waters, heated both by depth and the proximity of the molten mass, must have had very great solvent power. This resulted in the rapid solution of the walls of the fissures and deposition in their place of part of the burden of minerals held in solution. This interchange of minerals gives rise to "replacement veins."

Probably most so-called "true fissure veins" have had the original fissure much enlarged by replacement. While a "fissure vein" is generally distinguished by clearly defined walls and banded arrangement of minerals, and a replacement vein by impregnation of the walls and by a gradual fading of values into the country rock, we have every possible gradation between the two with the resulting difficulty in classification. With regard to the most important Rossland veins, there seems to be no doubt as to their class. No other veins in British Columbia have given rise to more careful examination and thorough discussion than these and there seems to be a complete consensus of opinion as to their origin. They are considered to be replacement veins along shear zones. At the Iron Horse, replacement of large crystals of augite by pyrite can be seen in every stage of completeness.

A peculiarity of this class of veins is that within the limits of the exterior fissures of the shattered zone, replacement may be along a single fissure, or the whole zone may be mineralized for a short distance

* Report by Mr. McConnell to the C.G.S , 1896.

and then the solutions may have penetrated through an opening to a fissure some distance away, which they followed upward and along which replacement again occurred. This peculiar distribution of the mineralized parts of the shattered zone brings corresponding difficulties into the mining of such veins. It makes the vein difficult to follow; it renders the limits of the vein obscure, so that the walls of one month may be within the ore body of the next; it makes necessary a large amount of dead-work in the search for possible bodies of ore and in handling large quantities of worthless country rock enclosed between mineralized fissures. If we add to these the extraordinary hardness and toughness of the country rock and the frequent displacements caused by faults and dykes, we have some of the gravest difficulties that mining engineers at Rossland have had to overcome.

The common Rossland ore is pyrrhotite accompanied by chalcopyrite bearing gold and a little silver. The pyrrhotite is generally massive and rather fine-grained, but it is also found disseminated through the country rock. It sometimes bears traces of nickel and cobalt. Gold values vary from traces up to several ounces to the ton; and silver, from traces up to four or five ounces. The chalcopyrite is very irregularly distributed. In some places it constitutes a large percentage of the ore and in others it is found only in isolated patches and grains Besides these minerals iron pyrites is met with in small amount almost everywhere and, in some of the mines of the camp, a little arsenopyrite, molybdenite, galena, zinc blende and free gold have been found. The zone of oxidation seldom exceeds a few feet in depth.

The distribution of the Rossland ore bodies is noteworthy. Most of the important ore bodies so far developed, occur on or close to the line of contact between the central volcanic neck and the surrounding porphyrites and diabases. The Le Roi and Centre Star, the War Eagle, and the Josie veins cross the line of contact on Red mountain. The Nickel Plate, Iron Mask, Virginia, Iron Horse, and Great Western are a short distance within the line. The Deer Park and Monte Christo occur close to it. The Kootenay-Columbia and the Iron Colt occur a few hundred feet to the north of it in a band of porphyrites, while, just beyond the line of contact to the south, in diabases and porphyrites, occur the Homestake and the Crown Point. Not all the ore bodies, however, occur in or near the central area. A few occur in the surrounding ancient lava flows. The general contact location of the principal veins indicates a line of weakness here.

Most of the best known veins, as the Le Roi and Centre Star vein, the War Eagle, the Iron Mask, the Nickel Plate, the Josie, and others, lie in a group on the southern slope of Red mountain, with a roughly east and west strike. These veins dip at high angles and approach and intersect one another in various ways, so that the whole group may be considered, dynamically, as forming one huge shear-zone. The Josie vein crosses the War Eagle claim. The Le Roi and Centre Star mines are on the same vein, which is intersected by the Iron Mask. A huge, dyke-filled fissure, one hundred feet wide, nearly vertical, and with north and south strike, cuts the Le Roi and the Josie. In fact, this whole group of veins, bound together since their formation, by numerous dykes and faults in common, occurring, as they do, in a great crushed and sheared belt, with similar minerals impregnating the walls of fissures that in many cases intersect, must also be very closely related in their origin.

The Rossland veins are cut by a series of dark, fine-grained, lamprophyric dykes. Since the veins must have existed before the dykes, and since the intrusion of the dykes no doubt followed somewhat closely the close of activity of the volcano, it seems probable that the mineralization of the veins occurred very soon after the consolidation of the rock. Doubtless the contraction on cooling opened a great many of the fissures and the solfataric waters caused rapid filling of the fissures with minerals and replacement of the walls. There has also been a more recent second mineralization with quartz, calcite, and zeolites, in veins cutting the previously mineralized rock. It is believed by Mr. Ferrier (geologist of the War Eagle—Centre Star Co.) that a second enrichment in gold occurred during this period. The largest fault has a throw of about four hundred feet.

Briefly summarizing the history of the development of this district we have:—

1. The development of the volcano.
2. The shearing of the monzonites and other volcanic rocks, giving a passage to solfataric waters.
3. Impregnation by metallic sulphides, silica, etc., along the shattered zone.
4. Continuation of the movements causing further faulting and shearing, probably accompanied by a filling of some of the fissures by dykes.
5. A second mineralization along these fissures.
6. Erosion of the volcano to its present level.

These ore bodies are generally being opened up by shafts, either vertical or on the dip, with levels on the strike, and much exploratory cross-cutting. The utility of such cross-cutting in this class of veins is well shown in the Le Roi, where, at one point, in the 700-foot level, the walls have successively receded until the stope has widened from less than 40 feet to more than 150 feet.

As development work to the extent of many miles has been done, and as considerable depths have been reached (in some of the mines one thousand feet and over), both values and size of the ore bodies being generally well maintained, the permanency of mining at Rossland seems assured for many years.

The total ore shipments for the year 1900 from Trail Creek mining division were 217,636 tons, with a gross value of $2,333,125. Of this, the Le Roi shipped 159,734 tons, valued at $1,437,726, and the Centre Star, 40,875 tons, with a gross value of $609,358.75. In other words, two hundred thousand tons of the total two hundred and seventeen thousand tons, or over ninety per cent., was shipped from this one vein.

In their roughly parallel arrangement, in their east and west strike and steep dip, in their igneous wall rock, and in their formation by replacement along fissures that frequently intersect, the group of veins on Red mountain resembles the famous group of copper-bearing veins at Butte.

GENERAL NOTES ON GOLD–COPPER DEPOSITS.

It will be seen that the auriferous copper-bearing ore bodies at Rossland, and those at the "boundary" present certain points in common. In both cases the ore is low grade and bears copper, as sulphide, and gold. Both groups of veins have been formed by replacement, and are large mineralized zones, with values fading into more or less ill-defined walls, rather than veins in the usual sense.

Both sets occur in volcanic regions, and in direct connection with igneous rock; and all these veins are disturbed and dyked by later igneous intrusions.

A comparison of fifteen of the best known and most important groups of copper veins in the Rocky Mountain region, most, if not all, of which are auriferous, showed that seven of the fifteen groups have igneous rock for one wall or both. In almost every case the district near the veins has been much disturbed by fissures, dykes, and faults. The very common occurrence of these veins in contact with limestones, as was seen to be true in the case of silver–lead deposits, is noteworthy. Probably the strong chemical activity of limestone is an important factor in the deposition of these ore bodies.

C. *Free-milling Deposits of Nelson Mining Division.*—Notes will be given on but one ore deposit in this district.

Example 7.—Ymir. This mine is at present one of the best dividend payers in British Columbia.

It is situated about five miles from Ymir station, on the Nelson and Fort Sheppard railway, with which it is connected by wagon road. It is on Ymir mountain, on the north fork of Wild Horse creek, a tributary of Salmon river.

The vein is a true fissure, with a strike of N. 70° E., and a dip to the north-west of 70 degrees. The vein is in slates, probably of the Nisconlith series, the strata dipping nearly vertically and having a strike nearly due north and south. Alteration is indicated by the presence of incipient staurolite and andalusite.

The horizontal length of the pay chute is about 500 feet. The width at the surface is about 15 feet, and increases considerably with depth. It outcrops at the surface, being merely covered with three or four feet of drift. Surface decomposition appears to extend to a depth of three or four hundred feet.

The walls are clearly defined and uniform. The ore body, which shows a banded structure, consists of galena, pyrite, and zinc blende, with gold and silver values, in a quartz gangue. The ore is free-milling, about two-thirds of the gold and silver values being caught on the amalgam plates, and one-third in concentrates, which are smelted. The values saved run about one and a half per cent. lead, one ounce in silver, and three to four-tenths of an ounce in gold. The galena of the concentrates carries silver, and the pyrite, gold. The vein is widening with depth, and values are being maintained with greater regularity.

A dyke, four to fourteen thick, the rock of which is apparently a minette, after cutting the vein with a slight dip to the east, turns and forms one wall for a short distance. At the 100-foot level, this dyke appears to split, following two fissures to the surface. It does not appear to affect the values in near-lying parts of the vein. Other dykes occur.

This ore body is opened up by adit levels on the strike. From the 300-foot level, with which the other levels are connected by winzes, an aerial tram carries the ore to the mill. At 1,000 feet below the surface outcrop, a cross-cut tunnel was being made at the time of the visit (May, 1901), on a level with the ore-bin at the mill. It was estimated that this tunnel would reach the ore body in 2,200 feet. This tunnel has since then been successfully completed, thus proving the vein to this depth.

From the general form of the vein, from the generally clearly defined and but slightly impregnated walls, and from the frequently banded arrangement of the minerals, this would seem to be the best type of a "true fissure vein" of those described.

CONCLUSION.

As already stated, the general type of ore in the Ymir and other mines in the Nelson District is intermediate between that of the Slocan, Ainsworth and Fort Steele mining divisions to the north and east and that of the Trail and Grand Forks mining divisions to the south-west. To the north-east we find silver, lead and zinc with a little gold. In Nelson, the central district, gold comes in more prominently and there is still a little silver and lead as seen in the Ymir concentrates. To the south-west again, in Rossland and the "Boundary," the ores consist of iron and copper sulphides with gold and but little silver. Galena has almost disappeared. It has been shown that the upper geological formations over this wide district are very diverse. Hence, reasoning back from the uniformly progressive character of the deposits from north-east to south-west, it would seem that the rocks whose constituents enriched the mineralizing solutions that formed these deposits, must be mainly below those formations now exposed. It seems reasonable to suppose that, deeper down, the fundamental igneous rock is fairly uniform in character and that, while varying considerably over wide areas in general composition, the transitions in composition of these rocks from point to point are gradual. Also, the general uniformity in character of the two main igneous intrusions (the "black" and the "white" dykes) seems to indicate that the composition of the residual bodies of molten magma at the time of the intrusions of the dykes was fairly uniform. The close relationship of the deposits to these igneous intrusions was noted above.

It is well known that, on cooling, rock magmas extrude large quantities of water and various gases, carbon dioxide, sulphuretted hydrogen, fluorine, etc., and probably volatile compounds of many of the metals. These, rising through fissures, must mingle with the underground circulating waters and not only enrich them, but also quicken their chemical activity, which owing to heat and pressure is already much increased.

The evidence, therefore, as to the origin of this large group of veins, seems to point strongly to the derivation of their metals, by underground circulation, in part, from the deeper portion of the zone of rock fracture and probably also, in part, from molten igneous masses intruded into the zone of fracture. This evidence seems to be directly in line with the view expressed by Lindgren of the U. S. G. S.:—

* "Where fissures traverse the cooling magmas, and the rocks surrounding them, it is natural that these mineralizing agents (emanations) carrying their load of heavy metals should ascend, at first under pneumatolytic conditions, above the critical temperature. Reaching the zone of circulating atmospheric waters, it is natural that they should mix with these, which probably greatly predominated in quantity. To this combinatien of agencies, found in the ascending waters of such regions of igneous intrusion, the formation of most metalliferous veins is probably due."

SILVER MINING IN ONTARIO.

(Continued from page 204.)

discoverer of this long-hidden treasure gave the appropriate title of "Shunia Weachu," or "Mountain of Silver," and is referred to in the special geological reports of the Geological Survey of Canada, as "a very strong and persistent fissure, showing at frequent intervals right across the mountains for over a mile." Along this outcrop (now embraced in the east and west sub-divisions) and for some distance below, the vein is large and solid and from 8 to 10 feet wide, while in the argillites lower down its width is more persistent, averaging sometimes from thirty to forty feet in width. The gangue consists mostly of calcite, with some baryta and a little colorless quartz and greenish fluorite.

The "West End," during its early bonding period, produced magnificent results in ore, even under the very worst conditions as regards transportation and accessibility, but it was not until 1888 that anything like even partially opening up a portion of the claim was seriously contemplated. During that year work was resumed on the property, camps erected, pumps and hoists installed, and development work carried on to a greater or less extent. In April of the following year several hundred feet of drifting and sinking had been done, and two shafts had been sunk at intervals of 500 to 600 odd feet apart. The main shaft had rich ore continuously from the surface. No. 2 shaft had also rich ore from near the surface, and the first adit level had a rich ore body that assayed as high as 3,000 to 18,000 ounces in silver to the ton.

The Canadian Northern Railway (Duluth branch) now runs directly through the silver region, and a very cheap rate of freight obtained for merchandise and supplies to the different mines, while ore and concentrates are very cheaply transported to the smelters.

In a word, the "West End" of Silver Mountain has produced approximately, in the short time that it has been operated, 350,000

* Trans. Am. Inst. Min. Engineers, Vol. 30, p. 692.

ounces of silver, and when opened up to connect with the upper and lower adit levels of the "East End mine," will but commence the brightest and most interesting page in the history of silver mining in this district.

THE EAST END MINE

The East End Silver Mountain mine is composed of Mining Location R. 53, one hundred and sixty acres, R. 54, eighty acres, R. 60, eighty acres, R. 151, sixty-eight acres, the north half of Lot 8, Concession 1, one hundred and sixty-one and a half acres (161½) acres, north half of Lot 9, Concession 1, one hundred and fifty-seven acres, north half of Lot 10, Concession 1, one hundred and nine acres, Lot 8, Concession 2, one hundred and forty-nine acres, in all 964½ acres, all in the Township of Lybster, in the district of Thunder Bay, and Province of Ontario, Canada.

The main vein on these properties is a continuation of that of the West End Silver Mountain, and development consists of a series of shafts, Nos. 1, 2, 3 and 4, upon which considerable work has been done. No. 4 shaft is 237 feet in depth, and is situated about 130 feet from the eastern boundary of the West End mine property. About five hundred feet of drifting in two levels has been done from this shaft. Other development consists of an adit level about 1,800 feet in length, connecting shafts Nos. 1 and 2, about 500 feet of intermediate levels and shafts have also been driven on the vein, and it is estimated from these workings that at least 9,000 tons of milling ore are now on the dumps ready for treatment, and there is now developed and available for stoping several thousand tons of ore of sufficient value to warrant a large increase in the present milling capacity, and it would seem wise for the company to install an additional plant at an early date.

In the centre of the property, and at the highest altitude, are two lakes, which will furnish an inexhaustible supply of water for all purposes. All the lands owned by the company are well wooded, as is the country adjoining, and this assures an ample supply of timber at a very reasonable cost for all mining and fuel purposes.

COMPANY NOTES.

Enterprise (British Columbia)—Cablegram from the company's representative at Nelson, British Columbia:—"Final June returns give a profit of $2,900 (£598). Estimated profit for the entire month of July $3,750 (£773), in each case exclusive of zinc production."

Ymir.—Cablegram from the manager at Nelson, British Columbia:—"During last month 50 stamps ran 631 hours (26 days, 7 hours); estimated profit on operating, $3,460 (£713). Above was arrived at after development, $1,300 (£267); repairs, $750 (£154); fighting fire, $1,300 (£267, etc, written off; total amount crushed, 3,330 tons (dry weight). Commencing 29th July.—Mine mill have been obliged to shut down three days owing to bush fires. The total loss is $3,000 (£618), flume, cordwood, labor. Do not apprehend any further danger from forest fires except to timber land. The mine continues to look about the same. We are at present running on better grade ore." (June.—Estimated profit, £1,412.)

Le Roi No. 2.—Manager cables, Rossland, 7th August:—"The shipments last month amounted to 5,675 tons. Contents, 2,949 ozs. gold 7,235 ozs. silver, 135 tons 15 cwts. copper. The return from ore, after making a deduction of all smelting charges, amounted to $49,450. Cost of mining may be taken at $21,500. Profits for last month, $27,950 (equivalent sterling, £5,763). No shipments for three days on account of wreck on railway." (June shipments, 6,316 tons.)

McDonald's Bonanza (Klondike).—Cablegram from Dawson dated 6th August:—"Skookum Claims—Total returns to date, 679 ozs. No. 2 Bonanza Clean up after six days, 161 ozs. From Bench Claims to date, 172 ozs. The estimated value is $13,250."

Slough Creek.—The following cable was received from the Company's consulting engineer, dated Barkerville, B.C., the 28th July:—"During the present week in East drift have met with feeder water—is not at all large, but having considerable force—face was securely timbered, upper part being in the gravel—no damage was caused—water rapidly draining off—there is not one-third at the present time—have decided to allow East drift to stand for a few days so as to relieve pressure—have recommended driving crosscut to the south—with difficulty have been able to secure one-half cubic yard gravel—has been washed in presence of Chairman—yielded one-half of an ounce gold, the size of wheat—the approximate value may be taken at £32 per sett—some of it supposed to have been lost owing to water—very fine washed, rounded gravel—it looks as if channel must be very rich—prospects are most encouraging—the most important feature is the water is gradually lessening—pumping one hour in each six hours, one pump."

Rossland Great Western.—Manager cables:—"Have struck good body of ore 600 ft. level Nickel Plate mine.—MacDonald."

Le Roi.—Cable from the manager at Rossland:—"Shipped from mine to Northport smelter during past month 14,500 tons of ore, containing 8,400 ozs. of gold, 14,000 ozs. of silver, 672,000 lbs. of copper. Shipped from dump to Northport during the past month 1,677 tons, containing 1,000 ozs. of gold. 1,350 ozs. of silver, 55,000 lbs. of copper. Estimated profit on this ore $100,000." (June return:—Shipped 11,475 tons, estimated profit $72,641, and from dump 3,353 tons, estimated profit $21,761.)

Report of Le Roi Mining Company, Ltd., for June, 1902:—

"Tonnage shipped, together with contents and gross values per ton:—

	Dry Tons.	Ozs. Au.	Ozs. Ag.	Lbs. Cu. wet.	Value per ton.
1st class.....	11,475	6,841	11,065	505,408	$17.70
2nd class dump..	3,353	1,627	1,760	75,829	$ 2.68
	14,828	8,468	12,825	581,237	....

"Mine expenditure:—The expenditure for the month on mine account was $47,823; the expenditure not charged to mine account was $895—48,718. The cost of breaking and delivering ore on the railroad cars for the month was $2.91 per ton. The cost of loading the second-class ore from dump, including putting on tramways and shutes, was $3.97 The cost of delivering first-class ore on the railroad cars, including all mine expenditure other than cost of loading second-class dump ore, was $4.05 per ton.

"Northport smelter:—The expenditure for the month was $156,220. The following statement gives the details of the ore received at the smelter during the month, and the contents:—

	Dry Tons.	Ozs. Au.	Ozs. Ag.	Lbs Cu. wet
Public ores:				
Le Roi No. 2.....	5,750	3,012	6,172	215,728
Le Roi ores:				
1st class.....	11,475	6,842	11,065	505,408
2nd class dump.....	3,353	1,626	1,760	75,829
	20,578	11,480	18,997	796,965

The tonnage treated during the month was as follows:—Roasted ores, 19,103; raw Le Roi No. 2, 5 725; raw Rossland Great Western, 52; raw Le Roi first class, 625, raw Le Roi second class, 1070; total, 26,575.

Profit for the month—			
The gross value of the first-class ore shipped from the mine was equal to a value per ton of.....	$17.70	equal to	$203,117
From this deduct difference between gross value and refiner's settlement rates and interest on gold and silver values for 90 days and copper 60 days.....	$2,88	equal to	$33,050
11,475 dry tons, net value, per ton.....	$14.82	equal to	$170.067
Cost of mining:..... $4.05			
Freight ..... .40			
Interest ..... .06			
	$4.51	per ton, equal to	$51,754
Cost of smelting 3.95			
Interest..... .03			
	$3.98	per ton, equal to	45,673
			$97,427
Net estimated profit.....			$72,540
The gross value of the second-class dump shipped was equal to a value per ton of	$12.68	equal to	$42,516
From this deduct difference between gross value and refiners' settlement rates and interest on gold and silver values for 90 days, and copper 60 days	1.55	equal to	5,197
3,353 dry tons at	$11.13	equal to	$37,319
Cost of loading on cars, laying tracks, and making chutes.....	.40		
Freight	.75		
Interest for 90 days	.01		
Cost of smelting	3.95		
Interest.....	.03		
Equal to.....	4.64		$15,558
Net estimated profit.....			$21,761

Monitor and Ajax Fraction, Limited—Report for the month of June:

June 30—Ore shipped and settled for—		
Crude, 76 tons, net proceeds.....		$3,158.39
June 30—Ore in hand—		
Crude, 78 tons, estimated net value.....	$5,000	
Screenings, 20 tons, estimated net value....	400	
Ore mined during the month—		
Crude, 23 tons, estimated net value	$1,625	7,025.00
Cost of mining, per ton.....$8.28		
Cost of mining, per ton..... 3.65 previous month.		
Development, 236 feet.		
Cost of development, per foot..... $6.57		
Cost of development per foot..... 7.10 previous month.		

The mine manager has been unable to make larger shipments this month

owing to the scarcity of cars. The leading "stopes" are now reported dry and in "good shape," and large quantities of carbonates, as well as crude galena will now be taken out.

Since the important strike in crosscut tunnel No. 5, reported last month the level has been driven 26 feet to the south, and a fine body of ore 3 feet in thickness has been encountered. Twenty tons clean ore have already been taken out of this short drift, and appearances show the paystreak to be improving in dimensions and in value.

During the month a good waggon load has been made from the portal of No. 5, which is carried over to the north bank of Carpenter creek by a strong wooden bridge, and practically connects the mine with the C. P. R. track. Arrangements have been made for a siding which will enable the company to ship direct from the mine in bulk, and thus effect an important saving in handling the ore and in transport charges.

The total net value of ore shipped *and settled for*, at the 30th June, gained during the previous nine months, was $44,989—say £9,000—and this, seeing the low prices which have ruled for silver and lead during the period, must be considered satisfactory.

The following report has just been received:—"Drifting on the ledge is proceeding very slowly on account of the large amount of ore which has to be saved. Since last weekly report the payshoot has widened to over 30 feet, 27 inches of it being solid galena of very high grade; this shoot lays against the footwall, on the hanging wall there is 4 inches of mixed ore, which is separated by the other streak, a horse being in the middle. This horse is getting smaller as we advance, and I expect to lose it altogether within a few feet." . . . "I have taken many average assays of the new strike, but am not yet far enough advanced to know the exact value. The iron assays 38 oz., the zinc 118 oz., and the galena from 149 oz. to 210 oz. . . . The ore comes in so fast that we cannot handle it."

NEW COMPANIES.

BRITISH COLUMBIA.

The Canadian King Consolidated Gold Mining Company.—Incorporated 4th August, 1902. Authorized capital, $150,000, divided into 1,500,000 shares of 10 cents each, Head office: Cheyenne, Wyoming, U.S.A. Canadian office: Erie, B.C.

The Canadian Ore Concentration, Limited.—Incorporated 6th Aug, 1902 Authorized capital, £150,000, divided into 150,000 shares of £1 each. Head office: Vancouver, B.C.

The Iowa Lillooet Gold Mining Company, Limited.—Incorporated 4th August, 1902. Authorized capital, $3,500,000, divided into 3,500,000 shares of 10 cents each.

The Willow River Mining Company, Limited.—Incorporated 6th August, 1902. Authorized capital, $50,000, divided into 500 shares of $100 each.

The Rossland-Kootenay Mining Company, Limited.—Incorporated 2nd August, 1902. Authorized capital, £150,000, divided into 150,000 shares of £1 each. Head office: Rossland, B.C.

The Chicago and British Columbia Mining Company, Limited.—Incorporated 19th July, 1902. Authorized capital, $1,000,000, divided into 1,000,000 shares of $1.00 each.

ENGAGEMENT WANTED BY MINING ENGINEER.

Mining Engineer of sixteen years' experience requires position as Superintendent or Consulting Engineer, preferably for a gold mining concern. Has had extensive experience in gold mining, milling and treatment of refractory ores, by amalgamation or cyanide processes. Also in coal, iron, and chromite mining. Is a good mine surveyor, mechanical engineer, and has a thorough knowledge of mine accounting. Address "REFRACTORY," *Canadian Mining Review*, Ottawa, Ont.

E. J. WALSH

CIVIL AND CONSULTING ENGINEER

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M. Can. Mining Institute.

OTTAWA - - CANADA.

CANADIAN MINING INSTITUTE.

A PUBLIC MEETING of Canadian Mine Managers, Mining Engineers and others interested in the mining industries of British Columbia and the North-West will be held under the auspices of the Institute,

IN THE BOARD OF TRADE, NELSON, B.C.

On Wednesday and Thursday Evenings, 10th and 11th September, 1901.

SINGLE FARE ON RAILWAYS.

Mining men and Members of the Institute will, by special agreement made with the Canadian Pacific and Grand Trunk Railways, be carried on these lines to Nelson and return for SINGLE FARE on obtaining standard Convention Certificates from their ticket agents and on having their certificates vized by the Secretary at the meeting.

A programme of papers of interest to Western mining men will be presented.

R. R. HEDLEY, *Chairman.* CHARLES FERGIE, *President.* B. T. A. BELL, *Secretary.*

MICA PROPERTIES FOR SALE.

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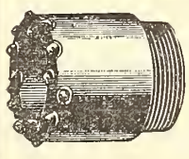
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The Crystal Gold Mine for Sale.

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WM. R. WHITE,
Liquidator of The Crystal Gold Mining Co. of Rathbun, Limited.

Dated PEMBROKE, June 26th, 1902.



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BRITISH COLUMBIA SECTION.

A PUBLIC MEETING of Mine Owners, Mine Managers, Mining Engineers, Assayers, and all who may be interested in promoting the welfare of the profession and industry of mining in British Columbia, will be held in the **CITY OF NELSON**, on

TUESDAY and WEDNESDAY, 9th and 10th SEPT., 1902

(AFTERNOON AND EVENING SESSIONS)

for the purpose of completing the British Columbia Section of the Institute.

A programme of papers of interest to mining men in the Province will be submitted for discussion.

B. T. A. BELL, *General Secretary.* CHARLES FERGIE, *President.* R. R. HEDLEY, *Chairman.*

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FOR 1902

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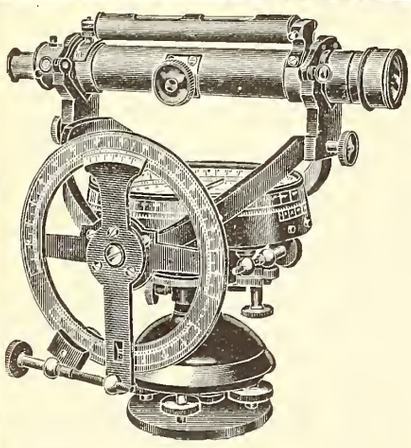
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For further information see the Calendar of Queen's University.

Next Session begins October 1st, 1902.

MATRICULATION EXAMINATIONS HELD AT QUEEN'S UNIVERSITY, SEPTEMBER 16TH

THE SCHOOL is provided with well equipped laboratories for the study of Chemical Analysis, Assaying, Blowpiping, Mineralogy, Petrography and Drawing. It has also a well equipped Mechanical Laboratory. The Engineering Building will be ready for occupation next session and the Geology and Physics Building the following session. The Mining Laboratory has been remodelled at a cost of some $12,000 and the operations of crushing, amalgamating, concentrating, chlorinating, cyaniding, etc., can be studied on a large scale.

For Calendar of the School and further information, apply to

The Secretary, School of Mining, Kingston, Ont.

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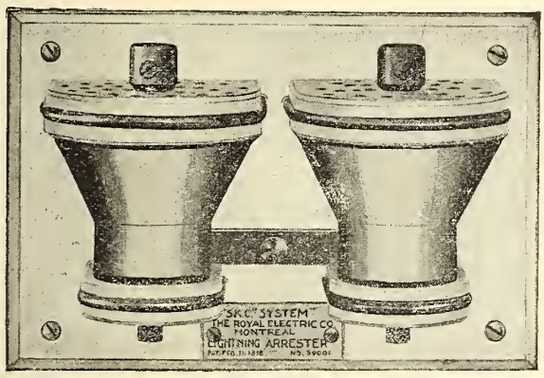
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GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents anuually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

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The attention of Miners and Capitalists in the United States and in Europe is invited to the

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Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at the mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order-in-Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end of the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 per acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee, $5.00, renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings, but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed or bars in the rivers below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River, and Hill claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim must hold a Free Miner's certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of 2½ per cent. on the value of the gold shipped from the Territory to be paid to the Comptroller.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek, or gulch, but the same miner may hold any number of claims by purchase, and Free Miners may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch, or river, by giving notice, and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00, and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette*.

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, at the rate of 2½ per cent. on the value of the gold shipped from the Territory. Operations must be commenced within one year from the date of the lease, and not less than $5,000.00 must be expended annually. The lease excludes all base metals, quartz, and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery, at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite: copper in sulphide and native form; gold, mostly in free milling quartz; silver, native and sulphides; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc, apply to

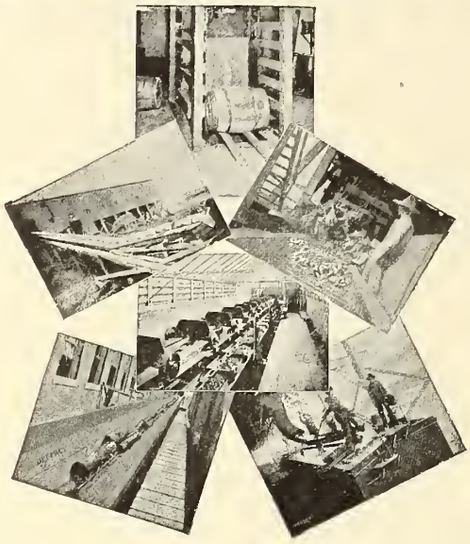
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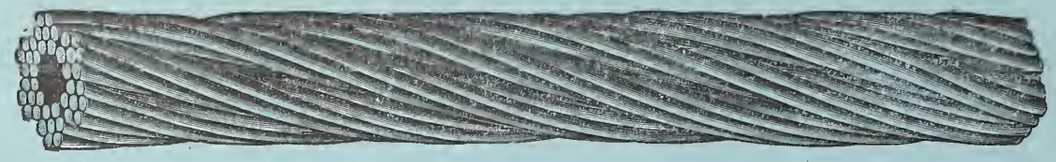
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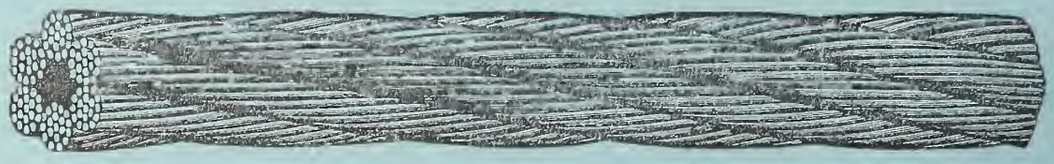
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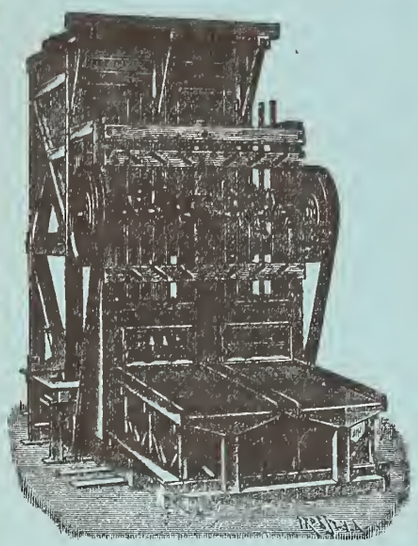
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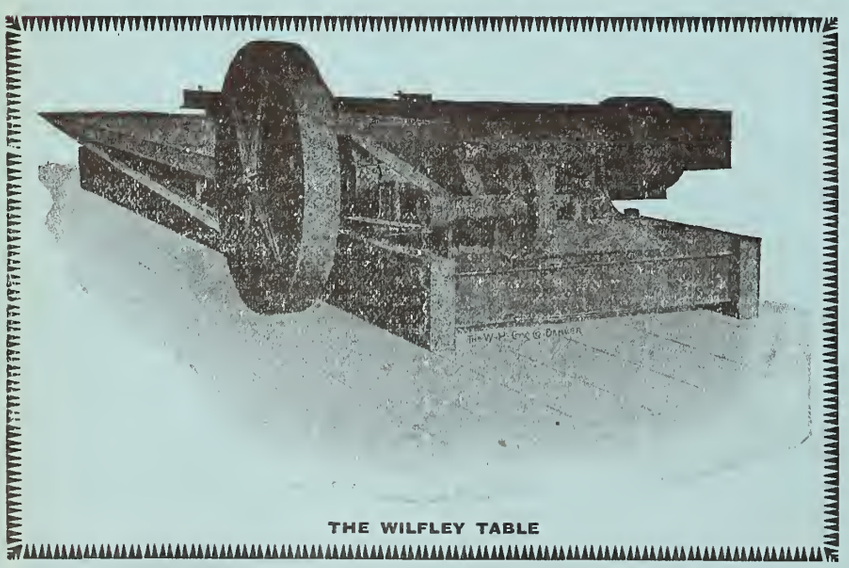
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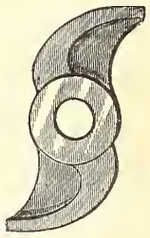
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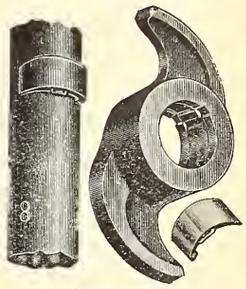


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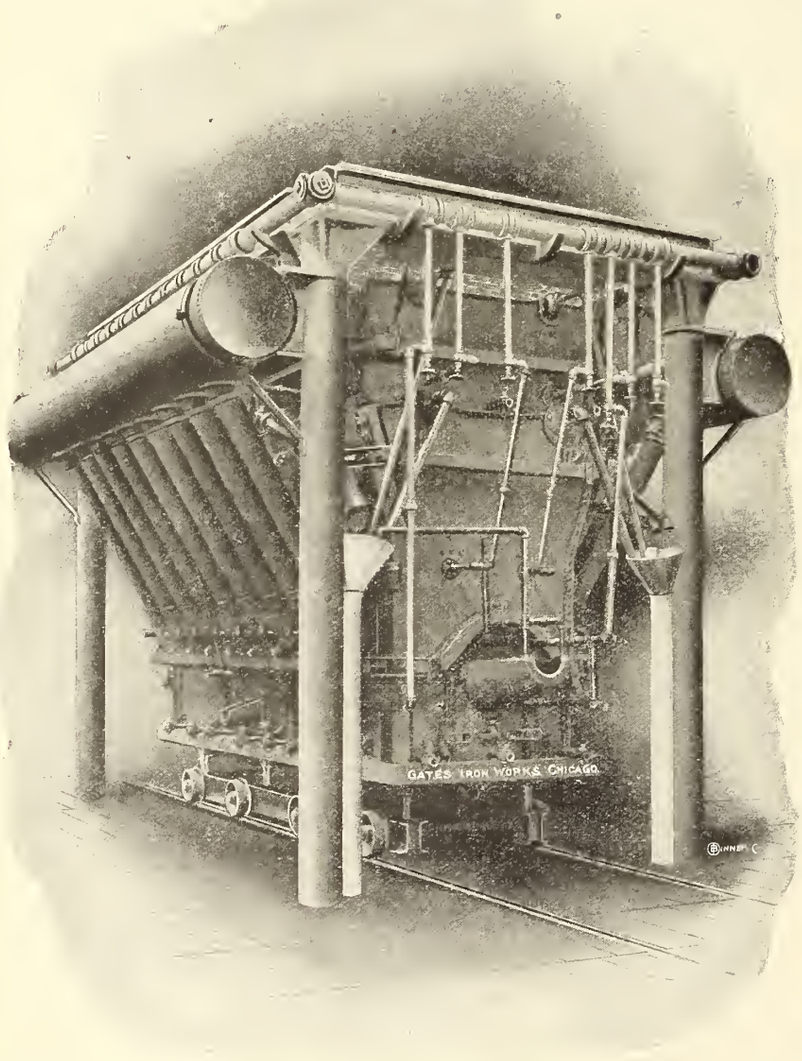
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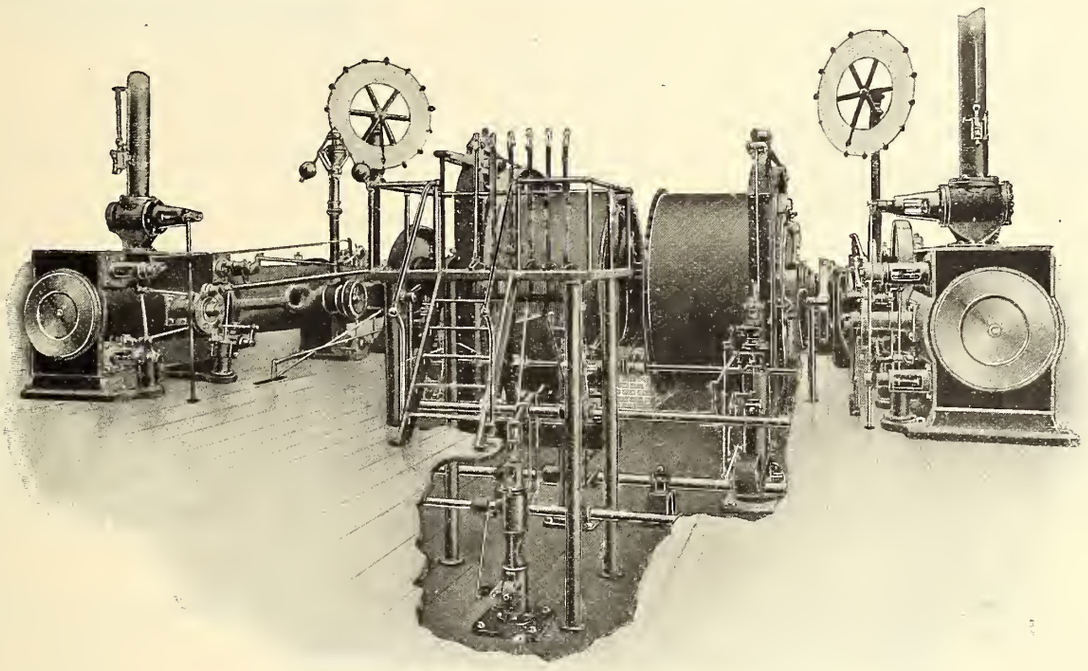
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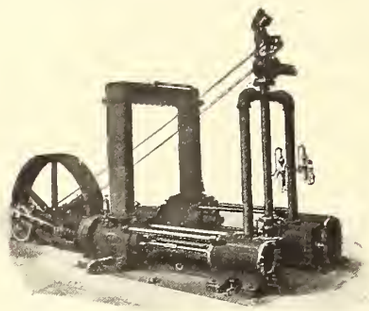
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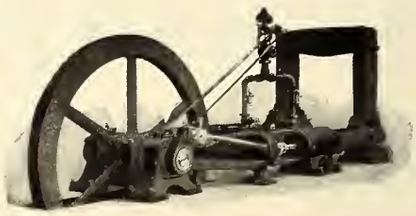
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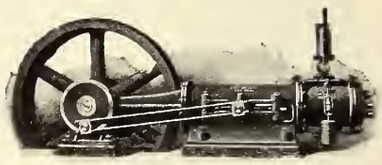
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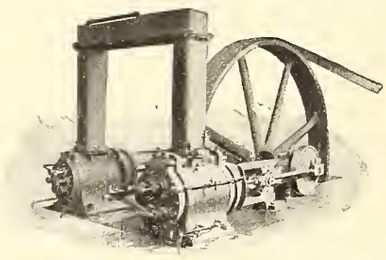
Class B-D Compressor
[Air Cylinders next to Frame]



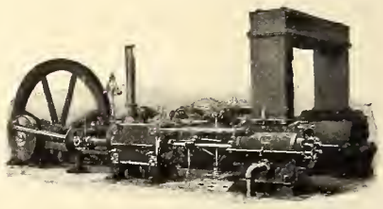
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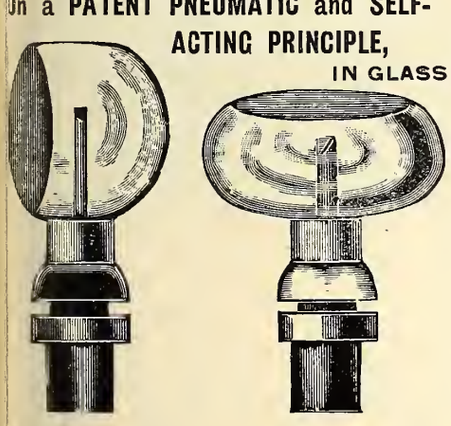
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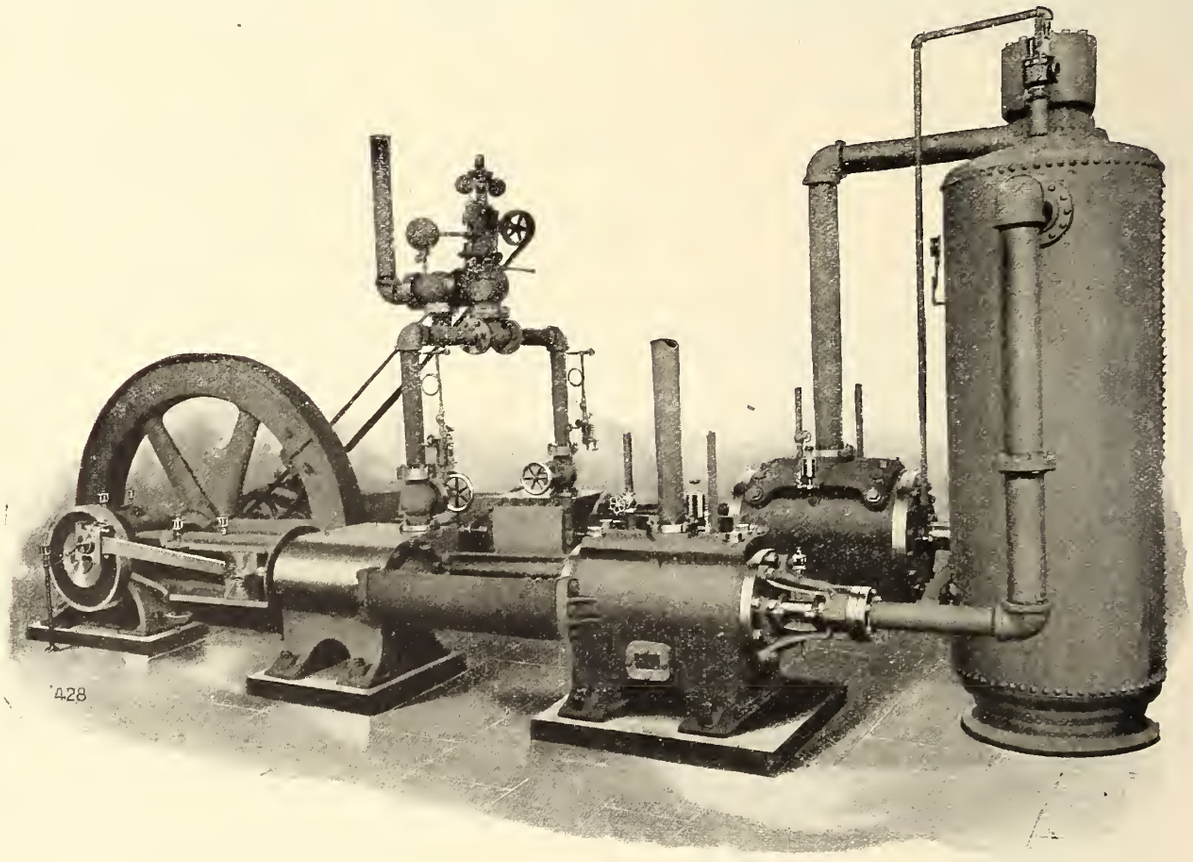
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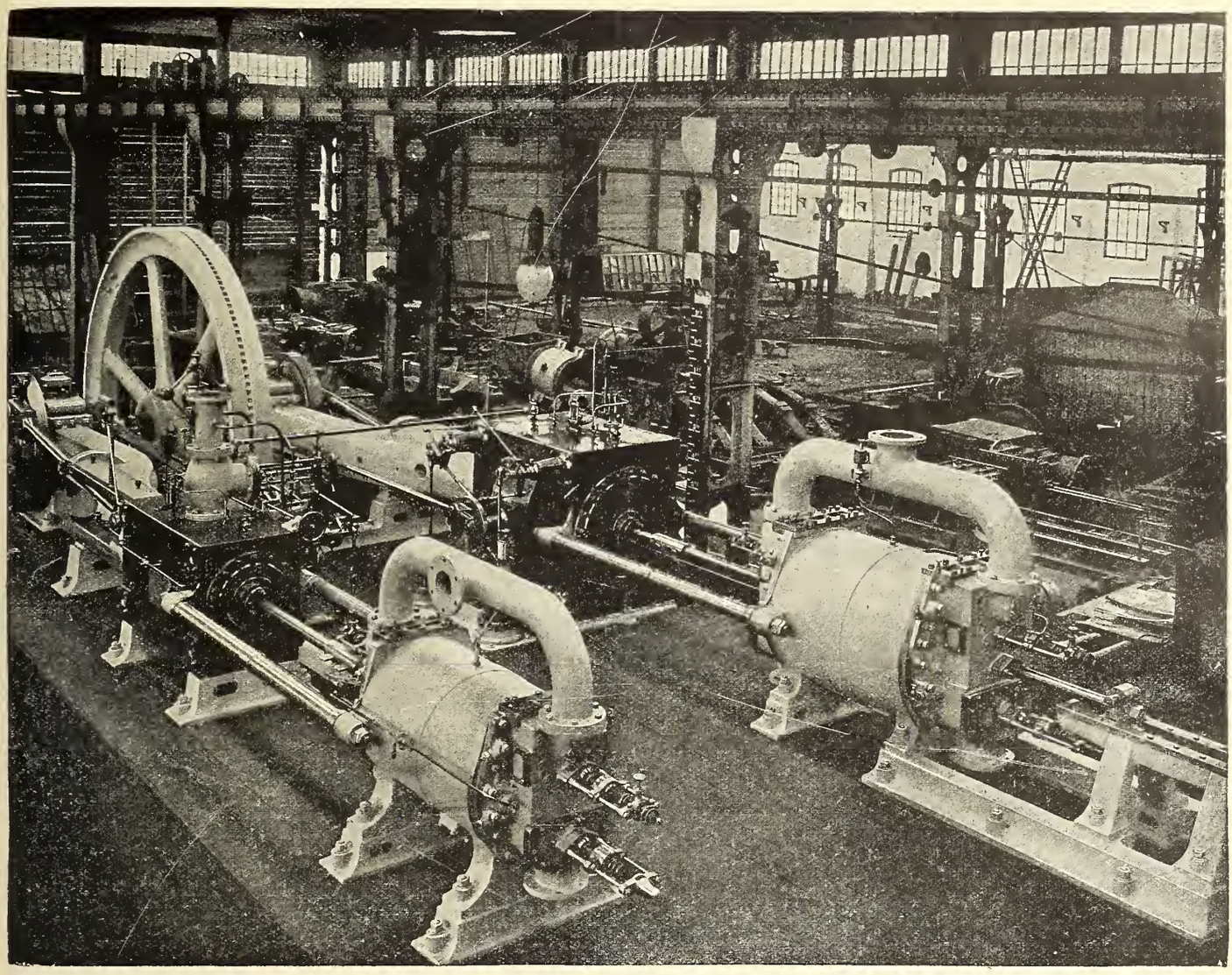
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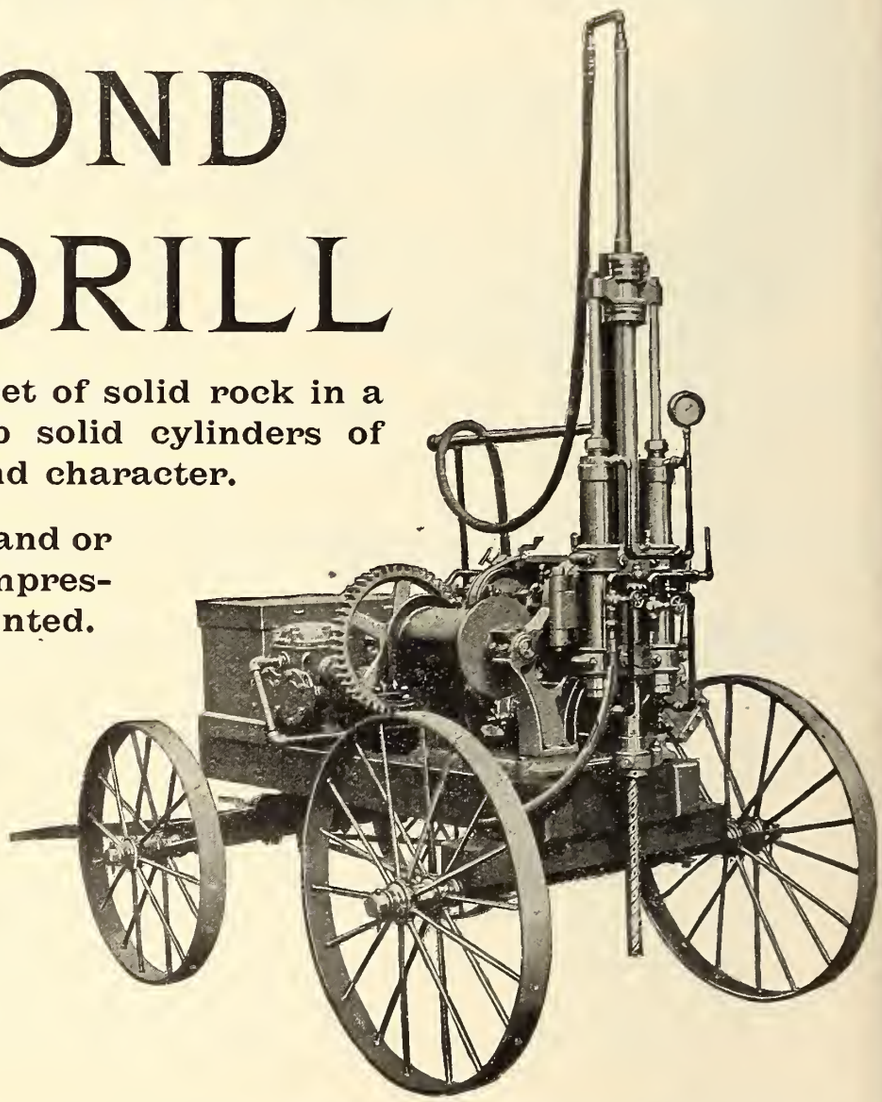
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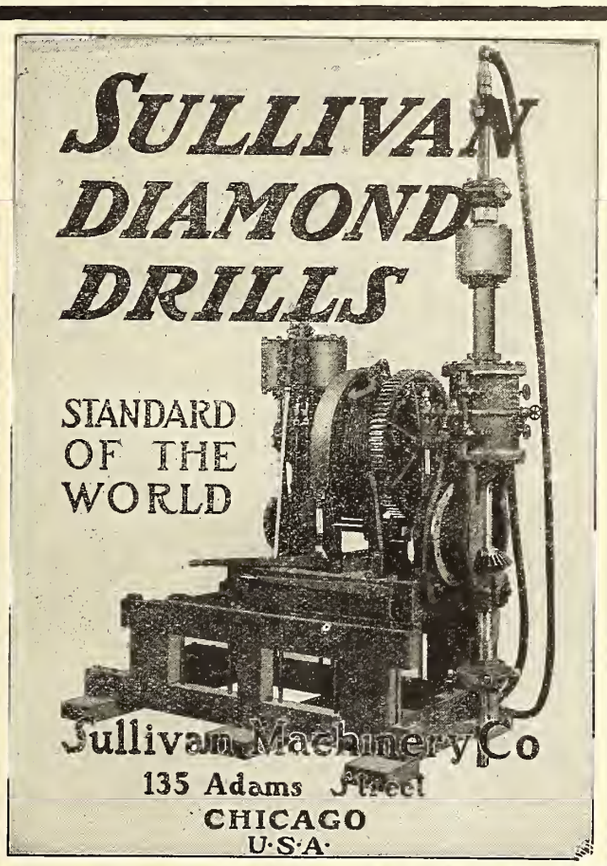
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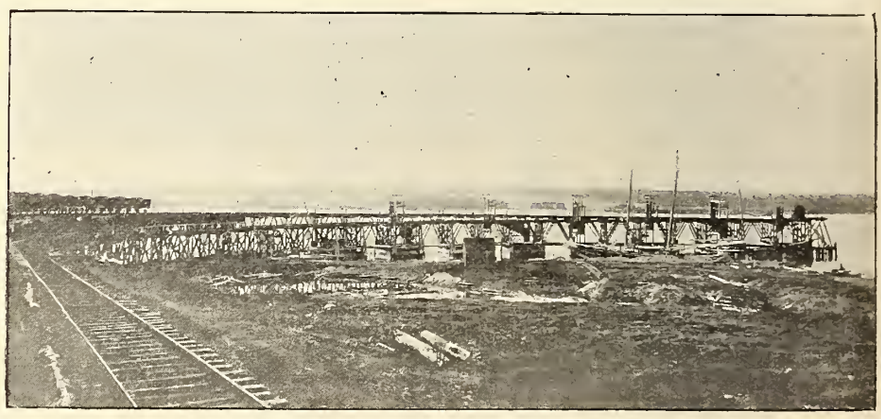
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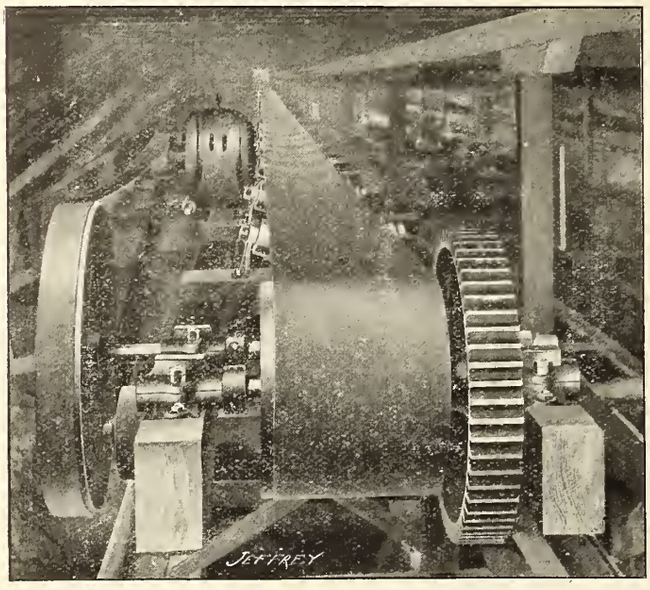
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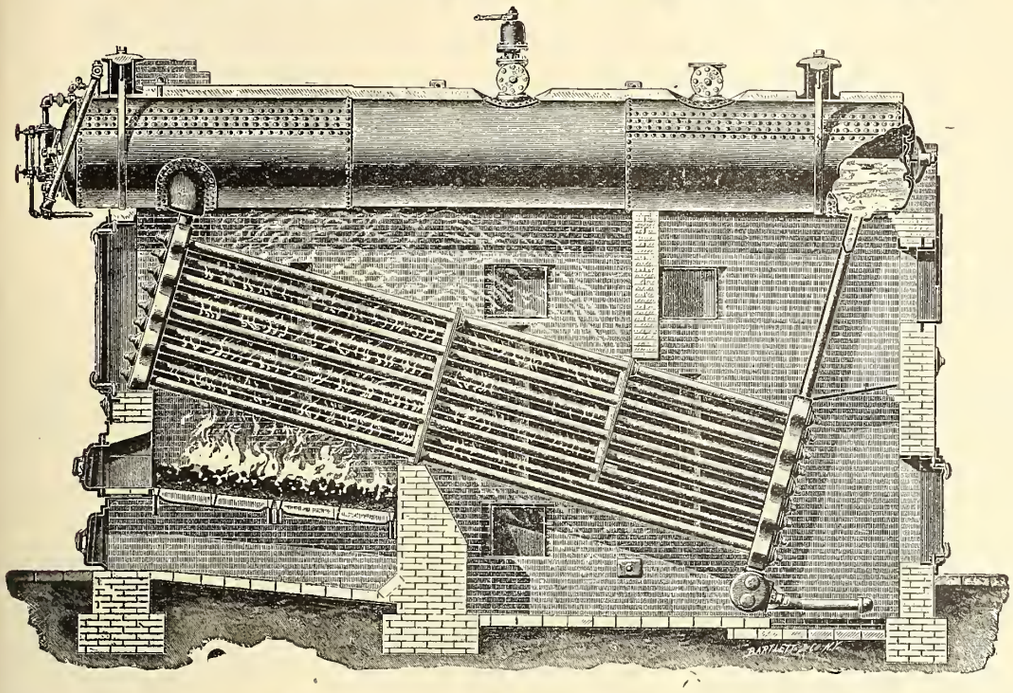
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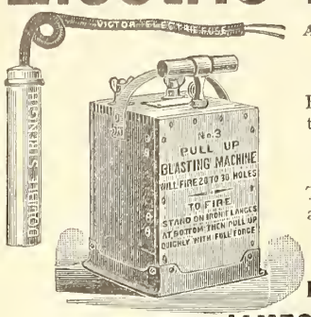
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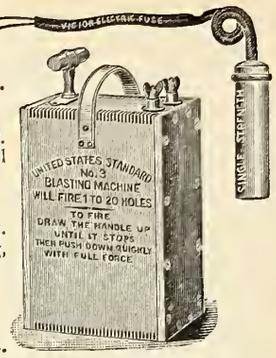
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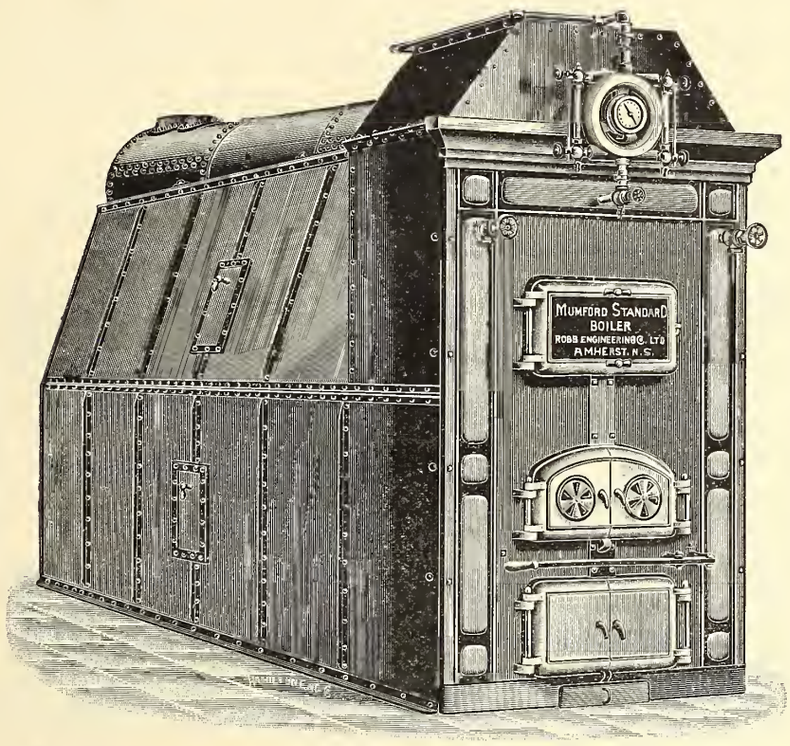
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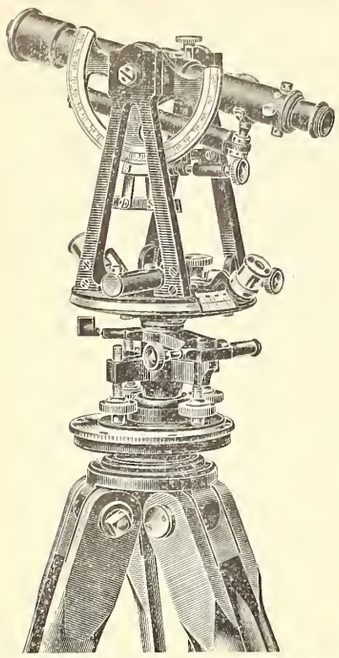
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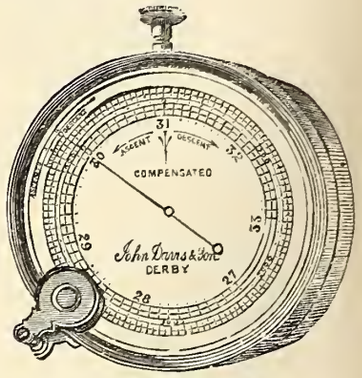
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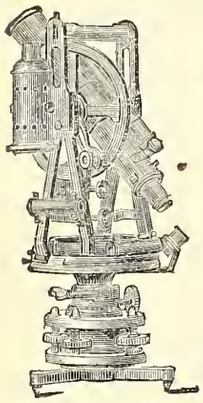
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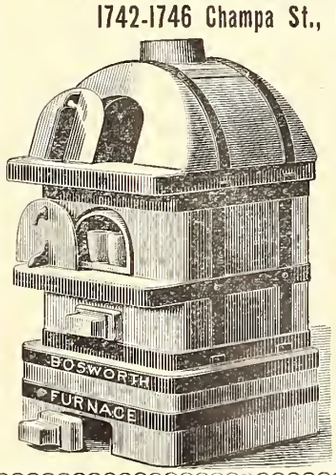
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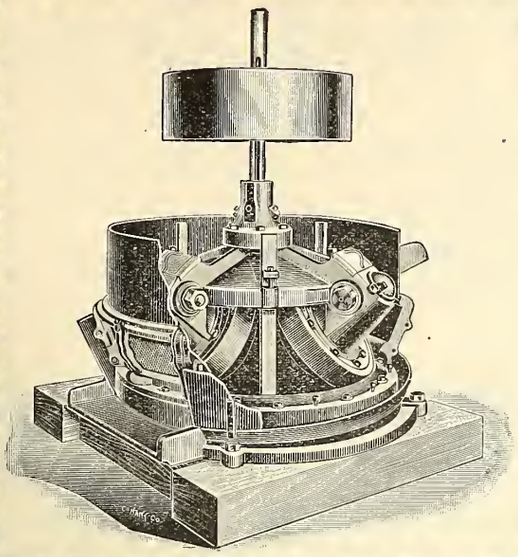
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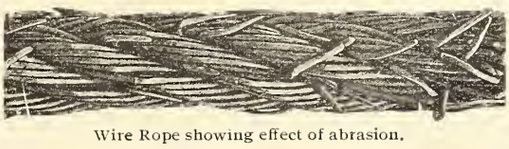
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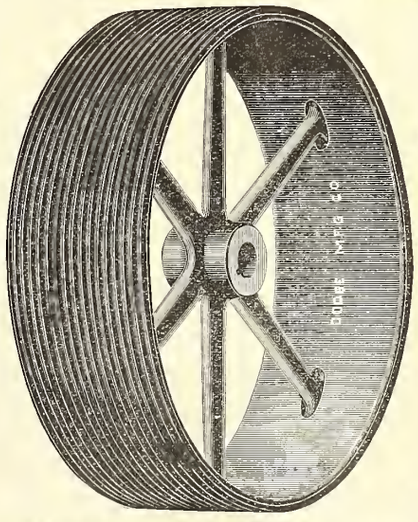


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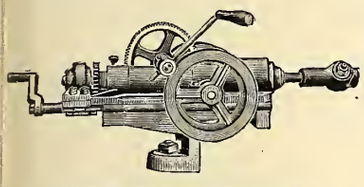
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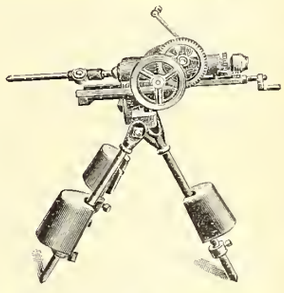
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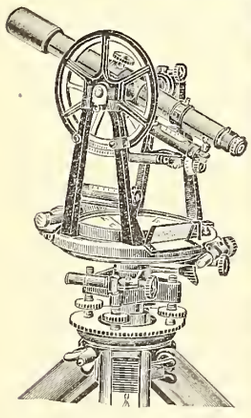
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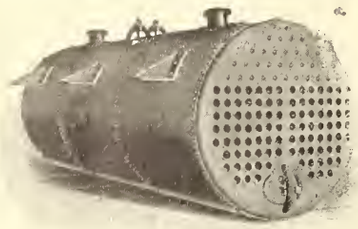
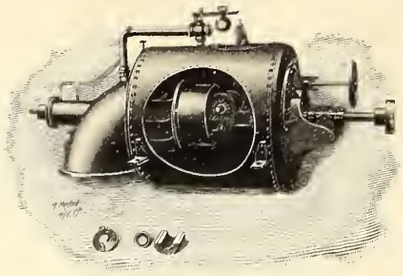
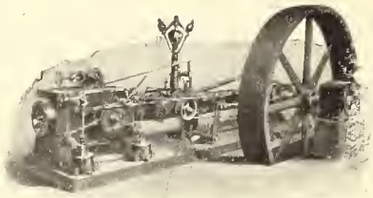
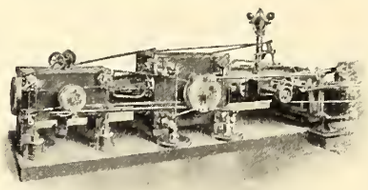
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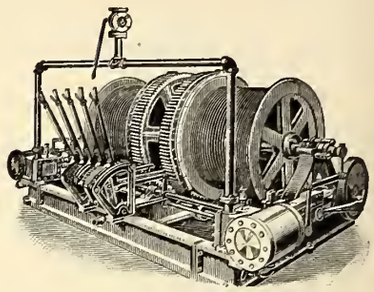
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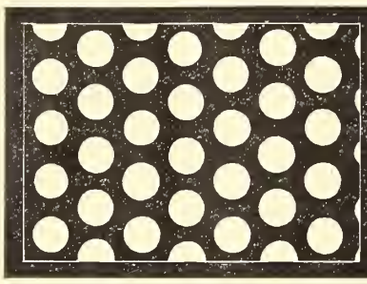
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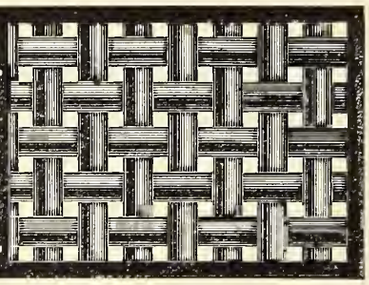


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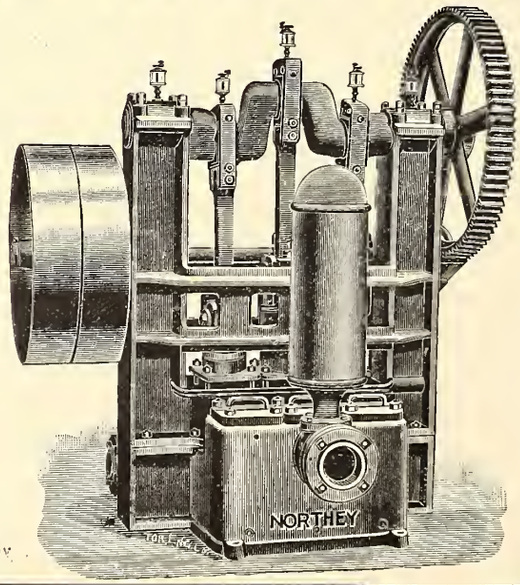
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Established 1882

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Secretary, Canadian Mining Institute, etc.

Published Monthly.

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VOL. XXI., No. 9. • SEPTEMBER, 1902. VOL. XXI., No. 9.

An English Expert on some Canadian Gold Mines.

The second edition of Mr. J. H. Curle's "Gold Mines of the World" differs from the first chiefly in its enlargement, so as to include the author's investigations into the mines of Victoria, New South Wales, Tasmania, and the North American Continent; the first edition dealt only with South Africa, West Australia, Queensland, New Zealand, British Columbia and India. The title which Mr. Curle has adopted is most comprehensive, and as the author's travels are extended doubtless future editions will justify the title; as it is, over three-fourths of the world's production of gold comes from the countries which this book endeavors to cover; the attempt is ambitious and the results as shown in the present volume are auspicious.

The value of Mr. Curle's book unquestionably is for investors in mines in South Africa and Australasia, as is evidenced when we state that 43 p.c. of the total number of mines indexed are in Australasia and 46 p.c. in South Africa, nevertheless, the author's honesty and sincerity, and his novel method of criticism, make the book valuable to an investor in any gold mine. He deals with mining from the financial, and not from the technical expert point of view but his sharp and trenchant criticisms of mining methods, and of methods of flotation and organization as practised in England, make his pages most instructive reading. Our regret is that Mr. Curle did not have at hand a complete fyle of Canadian papers for the last five years; with such a source of information he could doubtless have given many trenchant criticisms and memorable phrases concerning the phase of lunacy wich Canadian citizens exhibited during that period.

Our space forbids a summary of Mr. Curle's views concerning foreign gold fields, although we advise such of our readers as have investments in foreign mines to obtain a copy of his book and to study it. His personal knowledge of the South African fields lends weight to his predictions concerning their future; while he is not an enthusiast on Rhodesia he is decidedly optimistic concerning the Transvaal, and predicts an annual yield for that field, for many years to come, of $125,000,000. He believes that Western Australia will increase its production, but that the older colonies will remain practically stationary in their output; the West African fields he declines to judge, believing that they will require five years development before a sound opinion can be given; as to India no increase is looked for. Favorable words are spoken regardlng the United States and Alaska, but of Canada he has little that is good to say, and expresses the belief that the Yukon production has reached and passed its high water mark.

The interest in Mr. Curle's book for REVIEW readers is confined to some thirty-five pages of his text in which he writes concerning the Yukon, British Columbia and Ontario; Nova Scotia is given ten lines and no opiñion nor criticism is expressed. He considers that British Columbia must be regarded as the backbone of vein gold mining in Canada, and truly says that the mines there have been disappointing, "Prospecting and development work has not opened up the new mines which the appearance of the country justified one in expecting. This country, too, is badly handicapped in England because of the many worthless mines, of all sorts, which have been floated there." "British Columbia as a mining country has been much written about by mining men and theorized over by geologists;.....and the net result of it all, so far, is almost complete failure. English capital up to the present has been largely used to exploit the country, but English investors are now so disgusted with the dozens of valueless mines foisted on them that this vital source of income is almost dried up." Apropos of this statement, we might say that fully as much American as English capital, and twice as much Canadian as English capital, has been used "to exploit" the country. That very meagre results for the amount of money expended have been obtained is too patent to be controverted, and the REVIEW'S pages have told its readers, during the last half dozen years, many of the reasons why. Mr. Curle truly says that, if one deducts from the total gold production of the Province the individual yields of the Le Roi, War Eagle, Ymir, and Consolidated Cariboo Companies, that "there is no yield from any other gold mine worth noticing." The author shows great consideration for the feelings of his Canadian readers in suggesting that perhaps the reason that so few gold reefs have been discovered, up to the present time, is the fact that coal, silver, lead and copper have been found in such large and easily worked deposits that attention has not been directed especially to gold reefs, "But, whatever the reason is, both the yield of gold and the failure to discover new gold mines is disappointing.....The outlook for an increased gold yield commensurate with the country's great mineral area is not good."

He thinks the Atlin gold field is going to be a payable one, but that it will be profitable to companies and syndicates with large capital rather than to individuals; and we note the following phrase—"In a country like Canada, where litigation is made a specialty"—as indicative of one foreigner's opinion of British Columbia laws. He also has a few words of criticism for the Consolidated Cariboo Co.—"Here is, theoretically, the finest hyrdraulic mine in the world....For the future the mine is evidently at the mercy of the water supply,"—with which statement the shareholders, unfortunately, have been only too familiar for some years.

The Review is glad to quote the following paragraph from Mr. Curle—"Rossland gives me the impression of having been one of the worst handled gold fields I have ever seen, and a monument to the greatest evils with which mining has to deal." We commend Mr. Curle's criticism of this district to all of our readers. Summarized, he says that at the first, the richest ore being picked out and treated, outsiders were given the idea that the mines were unusually rich; in consequence prices went far above values. When the ore got to be low grade big outlays were called for which the majority of the shareholders, having already lost money on their shares, did not provide. Some of the mines went wrong in depth, "On the head of this came the London middlemen, floating unproved claims into big companies, bribing newspapers, and vitiating public opinion generally." The costs of working are fairly summarized as having been cut down from $13 (all charges included) to $9 in the most favorable case, viz., the Le Roi. Mr. Curle considers that the future of Rossland depends upon the Le Roi, Le Roi No. 2, War Eagle, Centre Star, Rossland Great Western, Kootenay and Iron Mask, of these the Le Roi is the best. Mr. Curle considers the Rossland lodes to be "Replacement veins, not fissures, and their continuance to a great depth can not be taken for granted." "They are capricious in the extreme both in size and values, and can never be assumed to exist one foot beyond where they are exposed." The Le Roi No. 2 is criticized and the final summary is in these words—"There is too little ore in sight to place any definite value on the shares." The Rossland Great Western is described as a property "That should not have been floated. The position of the company is not a hopeless one, but it is a bad one." The Kootenay is dismissed with the words "It is even a worse flotation than the Rossland Great Western."

Of the management of the War Eagle a good word is said, but nothing good is said of its reserves; as to the Centre Star, it "Should have done well.....but the payable ore extended only a little way into the claim and, worse still, it dipped rapidly into Le Roi leaving a big unpayable mass of ore in its place." The Velvet, Portland, Duncan, Granite, Poorman, Fern, Dundee, Porto Rico and Athabasca are dismissed with few words, but a word of caution is uttered respecting the Ymir which circumstances, occurring since the book was written, have shown to be wise. Mr. Curle insists that the profits for a year or two should be put into development, so as to give eight or ten years reserves in sight, and fears that some day the Ymir may come to an end in depth.

Passing to Ontario the first phrase met with is, "Ontario as a gold producer is so far a failure. Quite a number of places are known in this great territory where gold is found, and no end of official literature on the subject is turned out; but as for mines showing any signs of permanence—they simply do not exist; and the shares of those already floated are nearly all worthless." He alludes in detail to the three most prominent mines of the Lake of the Woods, the Regina, the Mikado, and the Sultana. In regard to the Regina we may supplement Mr. Curle's remarks by saying that it has been reconstructed into the Black Eagle, it has had over $100,000 spent upon it in twelve months time, and it is yet in need of more reconstruction, and of sound management. The Mikado's future Mr. Curle calls "doubtful"; for the benefit of our readers we say that the mine has been closed. The Sultana floated in London in 1899 on a capital of £275,000 stg., failed to discharge a mortgage of £10,000 held by a Canadian bank, and now finds itself (August, 1902) in the position of owing $9,000 besides the mortgage, and with no visible assets. The remarks made by Mr. Curle regarding these mines have, unfortunately for Ontario, proved only too true and are a strong endorsement of the views with which our readers are familiar, through these pages.

Mr. Curle gives a very just and reasonable account both of the methods and the costs of getting into the Yukon, but we can not say that his strictures on the White Pass and Yukon Railway Company are deserved; we think he has failed to take into account all the circumstances which attended the inception and execution of this enterprise and the justness of the tolls which the company exacted.

We concede to this book the very great merit of having been written with the intention of giving the facts with absolute impartiality. In some cases of which we have particular and special knowledge we may disagree with his conclusions, but judging his book from the Canadian chapter we must credit Mr. Curle with having written very valuable and honest information for the mining investor.

Mine Timbering by the Square Set System at Rossland, B.C.

By Bernard MacDonald, M.E., Rossland.

In mining operations, when the ore extracted exceeds a width of 12 or 15 feet, it has been found that the cheapest and only effective method of timbering is by the square set system.

The system may be generally described as a rectangular skeleton framework of timbers, extending from wall to wall of the vein as exhausted, the different members of which are so framed as to stiffen and support each other, and equalize and distribute local strains after the manner of a truss.

HISTORICAL.

The square set system of timbering was invented by Philip Deidesheimer, while Superintendent of the Ophir Mine, on the Comstock Lode, in 1860.

In Monograph IV. of the United States Geological Survey "Comstock Mining and Miners" the following reference is made which will be found interesting under this heading:

"At the fifty foot level (of the Ophir Mine) the vein of black sulphurets was only three or four feet thick, and could readily be extracted through a drift along its line, propping up the walls and roof when necessary, by simple uprights and caps. As the ledge descended, the sulphuret vein grew broader, until at a depth of 175 feet was 65 feet in width, and the miners were at a loss how to proceed for the ore was so soft and crumbling that pillars could not be left to support the roof. They spliced timber together to hold up the caving ground, but these jointed props were too weak and illy supported to stand the pressure upon them, and were constantly broken and thrown out of place. The dilemma was a curious one. Surrounded by riches they were unable to carry them off.

"The company was at a loss what to do, but finally secured the services of Phillip Deidesheimer, of Georgetown, California, who visited and inspected the treasure lined stopes of the Ophir."

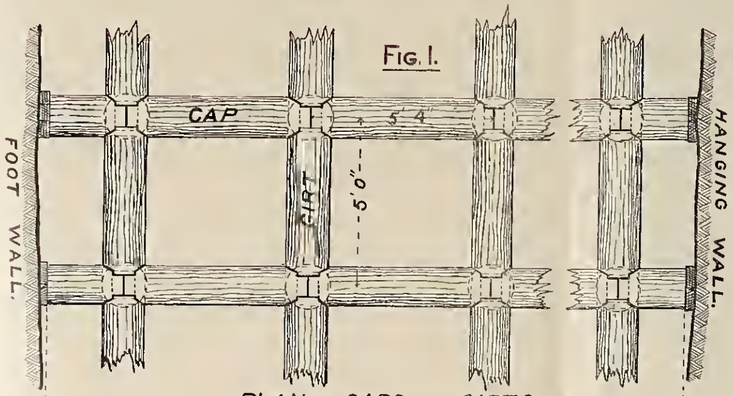
During Mr. Deidesheimer's engagement at the Ophir, all the principles of square set timbering were evolved under his immediate supervision, and the wide and rich ore-bodies occurring in that mine were successfully extracted without the loss of ore or injury from caving by the use of this system. The system was then used in all the mines on the Comstock Lode, and subsequently, in all metalliferous mines elsewhere where the ore bodies exceed a width of 15 feet, the extreme width that is practical to timber by stulling.

The "square set" has underwent numerous modifications of detail in dimensions and the framing of its members in the various camps where it has been since used, owing mainly to local conditions, the dip of the vein and the character of the ore bodies and the enclosing rock.

VEIN CHARACTERISTICS AT ROSSLAND.

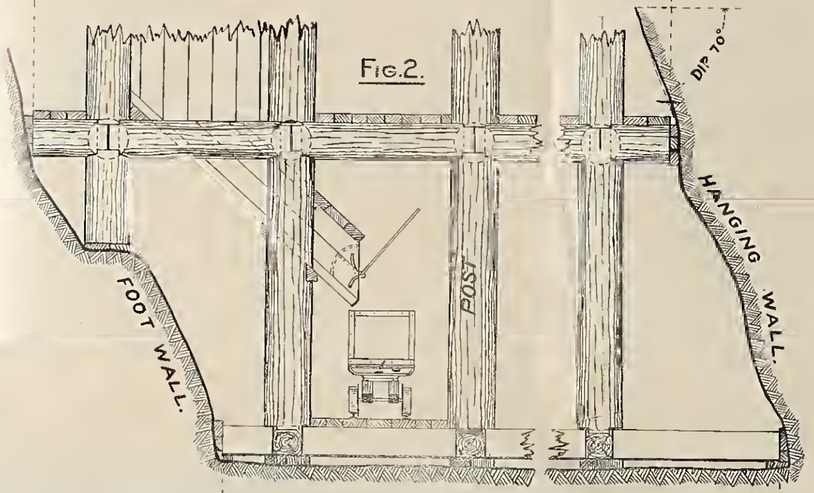
In the Rossland mines, the ore deposits have widths ranging u

Fig. 1.



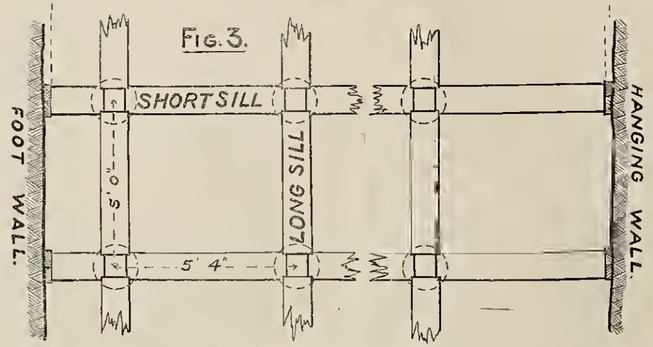
PLAN OF CAPS AND GIRTS

Fig. 2.



CROSS SECTION

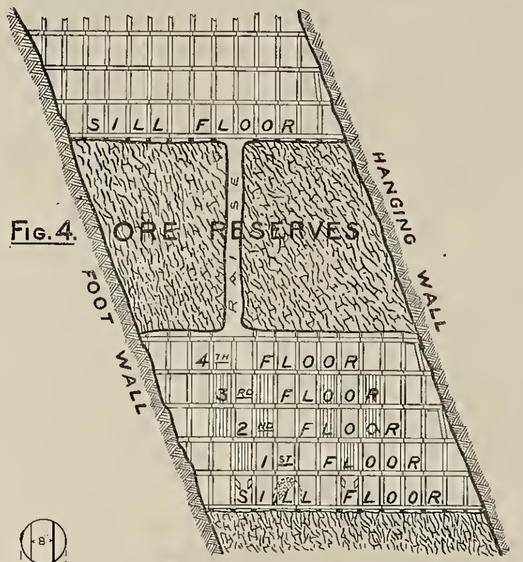
Fig. 3.



PLAN OF SILL FLOOR

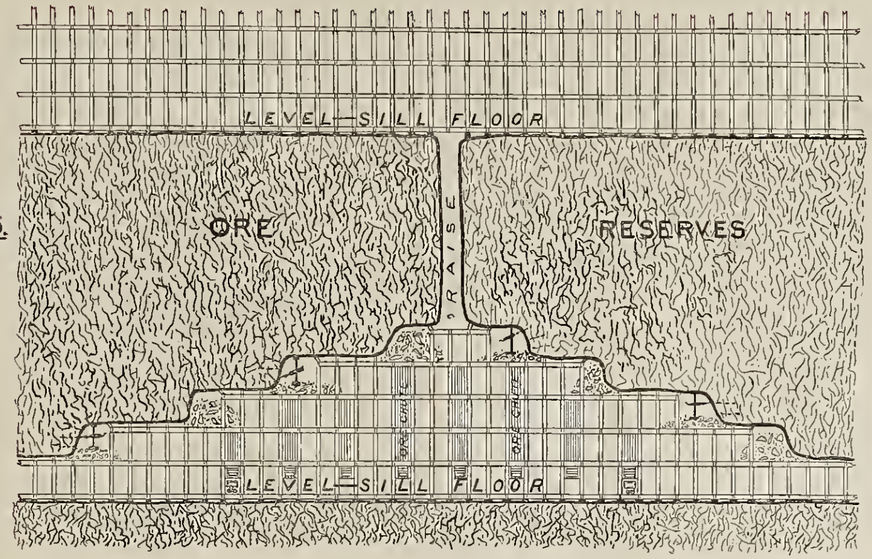
IDEAL CROSS SECTION

Fig. 4.



IDEAL LONGITUDINAL SECTION

Fig. 5.



FRAMED MEMBERS

Fig. 6.

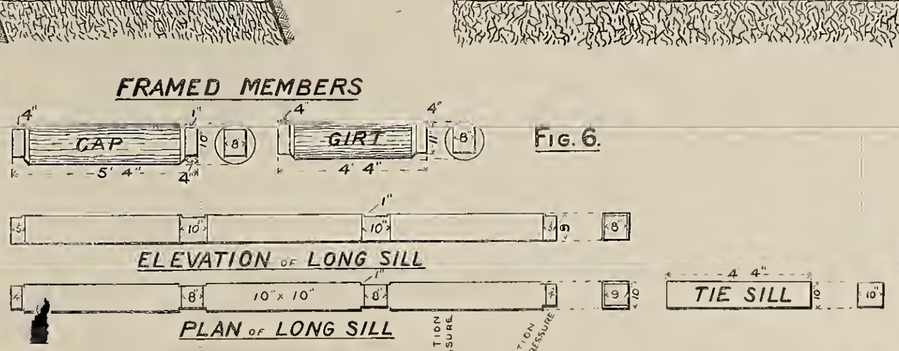
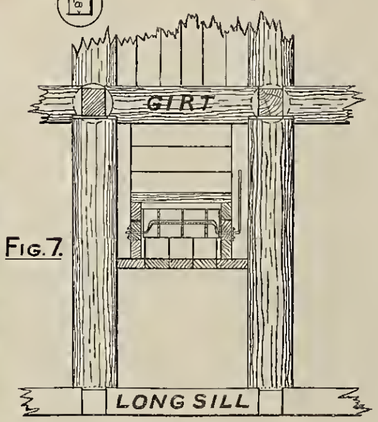
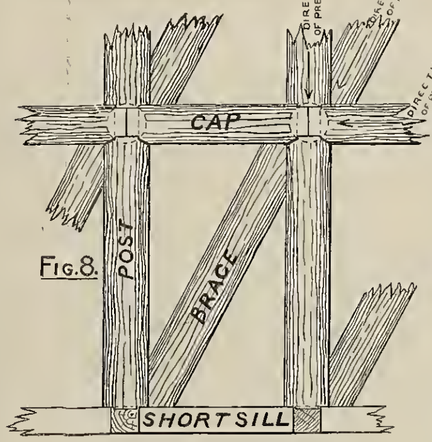


Fig. 7.



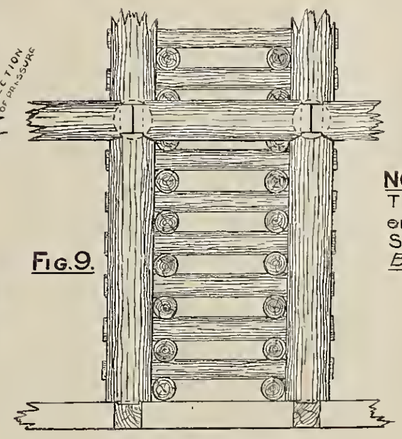
CHUTE

Fig. 8.



ANGLE BRACING

Fig. 9.



CRIBBING

PLATE
SHOWING
SQUARE SET METHOD
OF
—TIMBERING—
AT
LE ROI MINES
—ROSSLAND, B.C.—

SCALE 3/8 IN. = 1 FT.

12 0 1 1/2 3 4 5
IN FT.

NOTE.
This "Plate" to accompany paper entitled "Mine Timbering by the Square Set System", written by
BERNARD MACDONALD
ROSSLAND, B.C.

to 100 feet or more, and lengths of several hundred feet along the veins. The veins are sheer zone fissures, the vein-filling consisting of country rock, which is now found, replaced, and cemented to various degrees of completeness by auriferous pyrrhotite and chalcopyrite.

The ore and the enclosing rock may be designated as extremely hard, and the veins dip at angles of about 70°. These conditions facilitate and simplify timbering, without, however, doing away with its necessity.

PRELIMINARY WORK.

In stoping out these deposits, the work is begun at the level drives or drifts run in the vein, and continued upwards in steps or stopes.

The first work in opening up an ore shoot or deposit preparatory to extraction, consists of running drives or drifts through it from the level stations at the shaft, which are generally cut at distances of from 100 to 200 feet in depth below each other. Such drives may happen to be run along either wall of the vein, or, through the vein at any point or distance (usually varying) from either wall.

These drives are considered as random bores, made longitudinally through the vein to determine, in a general way, its course or strike, and the behaviour and characteristics of the ore shoot. They serve, besides, as preliminary thoroughfares for the traffic, drainage, and ventilation necessary for the preparatory work of stoping, to be hereafter described.

As generally run, the drives have widths of about six feet, and heights of about eight feet, and require no timbering, owing to their comparatively small size and the hardness of the vein rock.

When it is decided to begin stoping on any new level, the first work done is to excavate the ore along the drives from wall to wall of the vein, making the excavation of sufficient height to receive the "sill floor set of timbers, as the first series of square sets on the level is called, and to leave a space of two or three feet over the set. This space serves to provide room for blocking and wedging the timbers to place, and to receive a layer of old timbers, which act as a cushion in preventing the possible breaking of the timbers by the masses of rock that must be blasted down on them, as the work of stoping out the ore above proceeds.

SILL FLOOR CONSTRUCTION.

The sill floor is a framework, made of 10 in. x 10 in. sawn timbers, laid down on the working level in the ore body. They serve as the sills or foundation timbers on which the square sets are to be erected. It is, therefore, the first, as well as the most important part of the square set system of timbering.

Fig I, plate 1, shows the sill floor as laid down and ready to receive the "sill floor set" of timbers. The members of the sill floor consist of three pieces: the stringer, or long sill; the spreader, or short sill; and the butt spreader, or brace. These members, when repeatedly laid in duplicate, will make up a sill floor to any extent required by the size of the deposit.

The dimensions and details of the framing of these members are also shown on the plate.

The long sill measures 15 feet over all, and is framed from a 16 foot timber, which allows six inches to be cut from either end to square the piece and remove sun-cracks.

The short sill, as framed, measures 5 feet 4 inches in length, over all, three of which may be cut from a 16 foot timber, if it overmeasures a few inches, as it generally does, and the ends are sound.

The butt sill or brace is framed of varying lengths to suit the existing space, which generally varies owing to local bulgings or contractions of the vein. It is framed on one end exactly like the short sill, while the other is cut square or bevelled to fit or butt against the wall rock, from which it is wedged tightly to place against the long sills.

A description of the method of framing the sill floor set of timbers is not needed, as it will be fully comprehended by a glance at the figures on the plate.

In laying the sill floor, the long sills are set ends abutting flush against each other, and as nearly as possible parallel with the general strike of the vein, ignoring any local bulging of the walls.

The first sill is laid close and approximately parallel to the foot wall, in which position it is levelled and held by blocking or butt braces; the other long sills are laid paralleling this one at proper distances apart, that is, 5 ft. 4 in. between centres. The cross sills fit on top of these, lying level with them, the ends being halved in framing to rest into similar halvings in the long sills, and to abutt flush against each other and extend endwise from wall to wall of the vein.

When the long sills reach as near the hanging wall of the vein as desirable, they are braced from it by the butt spreaders or by blocking, wedged tightly to bring all the members into proper position. The philosophy of this design of the sill floor is as follows:—

The long sill is made 15 feet in length, so as to better sustain the superstructure of square sets erected on it when the ore upon which it rests comes to be stoped away. For instance, when the ore is being blasted from under the sill floor by the work of stoping coming from the level below, and the blasting tears away a portion of the ore upon which the sill floor rests, making an opening as it generally does, of, say, 8 x 8 feet, the long sills would over-reach such opening, and one or both ends would rest on the solid rock beyond. Nor would the short sills drop away through such opening, owing to the fact that they rest on the top of the long sills, as previously described and shown on the plate.

Through the opening thus made in the ore, the portion of the sill floor exposed would be supported by posts set on the timber sets in the stope below. Thus the long sill operates to allow the work of stoping out the ore upon which the sill floor rests to be safely conducted if such portions of the sill floor as become exposed as the work proceeds are properly supported by posts from the timber-work underneath.

TIMBERS AND METHODS USED AFTER SILL FLOOR IS LAID.

The first tier of square sets erected on the sill floor is known as the "sill floor sets." The assemblage of the framed timbers into square sets then proceeds upwards, by floors, set over set, vertically, *pari passu* as the work of stoping exhausts the vein. The timber structure over any level is referred to in subdivisions as the "sill floor sets," "first floor sets," "second floor sets," and so on until it reaches the level above and catches up and supports the sill floor on that level.

This method of reference to the timbering as it advances, carries with it the data for a general calculation of the portion of the vein exhausted over a level as each set of timbers in place indicates that 9 feet vertically and 5½ feet horizontally of the vein is exhausted, 9 feet being the bare height and 5½ feet the width of space required for a set of timbers. And each square set in place indicates that 24 tons of vein matter have been extracted.

Aside from the sill floor, all the timbers employed in the square set system, except the planks for floorings and chutes, are framed from round logs. These logs are preferably of red fir, it being the strongest native timber, but pine, spruce and tamarac may be used. When cut in the woods, the logs are peeled and allowed to season for a period of from six to twelve months, during which time they lose about one-third of their green weight, which is a very important advantage in subsequent handling. In diameter, they range from 12 to 20 inches, but generally average about 16 inches, and are sawn in lengths of 16 feet 6 inches.

The logs may be framed by hand or with machine saws into the various members of the square set, as follows, viz.: Posts, caps, girts or braces, and butt caps. Like the members of the sill floor, these members may be duplicated to any extent required by the size of the excavation to be timbered.

The posts as framed are 8 feet 2 inches over all; the caps are 5 feet 4 inches, and the girts or braces are 5 feet; the butt caps, like the butt spreaders on the sill floor, are cut in varying lengths to suit such spaces as may exist.

The details of framing the logs into members of the square set are plainly shown in figures on Plate I, and need no further description. The philosophy of this method of framing the timbers is that the cap pieces of the various sets form continuous stringers of timbers running horizontally from wall to wall of the vein, no matter what this distance may be. Such stringers offer the end grain or greatest strength of the timbers to the walls, from which the greatest strains are generated. The posts and girts rigidly support the stringers thus formed of the several cap pieces in true horizontal position, bearing on the joints from right angled directions, while the cap pieces and the girts support the posts in true vertical position.

The whole framework forms a strong rigid structure capable of indefinite extension upwards and longitudinally as stoping proceeds, allowing at the same time for any expansion and contraction in width to suit such irregular widths of the vein as may occur.

Besides the functions of the various members of the square set system to support each other in the manner described, that of the cap pieces is to receive directly and sustain the strains coming from the walls of the exhausted deposit, while that of the posts is to support the vertical weight coming from the undercut ore deposit and the broken ore lying on the floors, but strains coming from any direction are distributed over all the members of the set.

The system possesses, to a considerable degree, the qualities of a truss, and makes it possible to extract all the ore of any deposit and effectually secure the enclosing walls from caving in. When the framework comprising the sets is erected, a floor, consisting of 3-inch plank, is spiked down on the caps of each floor set. These are the working floors on which the miners operate the machine drills, in the method shown in Fig. 5. When the ore is dislodged from the vein by blasting, it falls on these floors, where the waste or second class ore may be sorted out from the shipping ore. The shipping ore is shovelled into chutes which are built of 4-inch plank spiked to the timber framework and carried upwards with the square sets, as shown in the plate. The second class ore or waste sorted out, may be stored temporarily or permanently in the framework of the timbering from whence it may be drawn off at any time through chutes, should removal elsewhere be desired.

Figs. 4 and 5 are ideal cross and longitudinal sections illustrating the method of timbering and the work of stoping as it is carried on between the levels. Fig. 4 is a cross-section through the line A–B on Fig. 5, which in turn represents the longitudinal section through the line C–D on Fig. 4. On Fig. 4, the original position of the level drive in the vein is assumed as shown at the point X. This drive, as already stated, furnishes the point from which the excavation of the vein matter for the sill floor is commenced.

The step method of excavating the ore is shown in Fig. 5, where stoping is proceeding in double-headed steps, each step excavating the ore from wall to wall and having a vertical height of 9 feet in the clear, which allows of the erection of one floor of timber sets, which in turn provides the scaffolding from which the miners may attack the ore above.

In stoping out the ore on any level, the ordinary method is to keep the sill floor at least 30 feet in advance of the first floor, and it about 30 feet in advance of the second, and so on, as is shown in Fig. 5. One machine-drill, or generally two, in case the vein is wide, are assigned to work the two opposite headings of any floor, going in opposite directions, working on each heading alternately. When one face is drilled and blasted, the machine-drills are changed to the opposite face, and the shovellers pass the broken rock into the chutes, or sort it, if sorting is required. When the ore broken is thus removed from the face the timber gang erects another unit of timber there, and the stope is again in readiness for the machine drills, which have by this time finished drilling on the opposite face.

Generally the step method of stoping proceeds in opposite directions from a raise, run through the ore body between the levels, as shown in Fig. 4. The framed timbers are delivered in the stope by dropping them down through this raise or hoisting them from the level. Sometimes the framed ends of the timbers are injured by dropping them through the raise, but as a rule no material injury is done to them, while the time gained by this method is a very important factor in cheapening the cost of timbering, compared with hoisting piece by piece from the sill floors underneath.

PER TONNAGE COST OF SQUARE SET TIMBERING.

After the sill floor is laid and the framework started, a square set, which is made up of one post, one cap and the brace, consumes 18 feet 6 inches running feet of logs.

The logs peeled and seasoned cut measuring 16 feet 6 inches cost $1.20 each delivered f.o.b. the cars at the works, or about 8 cents per running foot. Therefore, the 18 feet 6 inches required for the set would cost $1.48, or say $1.50 unloaded in the framing shed, provided the logs are not cut to waste in framing, which may be avoided with a little care and foresight.

The cost of framing the pieces comprising the set would be about $0.553, when framed by hand labor, carpenters being paid $3.50 per day of nine hours.

COST DATA PER SQUARE SET, HAND FRAMED.

Material.—A log, measuring 16 ft. 6 in., costing $1.20, cuts into two posts, or three caps, or three braces; therefore:

Material in one post costs	$0 65.0
" " cap "	0 43.0
" " brace "	0 43.0
Total cost of material in one set is, say	$1 50.0

Labor.—One carpenter (wages $3.50) frames per day:

About 21 posts, costing each	$0 16.7
About 21 braces, "	0 16.7
About 16 caps, "	0 21.9
Total cost for framing	$0 55.3
Total cost of labor and material in set	$2 05.3

The details of cost of the individual members of the set framed on the surface, ready to go into the mine are therefore as follows:—

1 post costs, for...	Material	$0 65.0	$0 81.7
	Labor	0 16.7	
1 cap costs, for ...	Material	0 43.0	$0 64.9
	Labor	0 21.9	
1 brace costs, for..	Material	0 42.0	$0 53.7
	Labor	0 16.7	
Making the total cost			$2 05.3

The costs next attaching to the square set, or unit, of this method of timbering are:

Lowering into the mine	approximately	$0 10
Delivering to place required	"	0 10
Labor in erecting	"	1 50
Incidental material, such as blocks, wedges, tools, nails	"	0 10
Cost of sill floor, averaged over 11 sets between levels 100 ft. apart	"	0 15
		$1 95

These costs last above given may vary greatly, being increased or decreased with the completeness of the facilities for handling the framed timbers, the cost of the several items as stated may vary accordingly from time to time, but the total will be about the average cost, and will closely approximate that of carefully supervised operations. Therefore, from the foregoing it will be seen that the cost of the square set placed in the mine will come down, as follows:

Total Cost of Labor and Material, as above.....	$2 05.3
Labor and material when set is in place as above.....	1 95.0
Total cost say	$4 00.0

When framed by machine saws, the cost of framing a square set does not exceed 30 cents, including the cost of power, as against 55 cents by hand, a difference of 25c. per sett. Therefore, if the framing is done by machinery, the cost of a set in place would be $3.75 as against $4.00 as shown above when the framing is done by hand work.

The per tonnage cost for timbering by this method works out as follows :—The average space to be excavated for each set square is 5.3 feet wide by 5 feet long, by 9 feet. in height, or 240 cubic feet. The Rossland ores, being heavily impregnated with iron and copper pyrites, yield a ton of 2000 pounds for each 10 cubic feet of ore in place; therefore, from the 240 cubic feet of vein required to be excavated for a set of timbers, the yield will be 24 tons. If the timbers were framed by hand the cost of timbering, so far as described, would be about $0.17 per ton; if by machinery, $0.15.6, a difference of $0.01.4 per ton in favor of the machine-framed sets.

In addition to the costs above tabulated, there still remain the costs of the chutes, floors, ladders, and railings, necessary for the convenience and safety of the miners and the passage of ore and supplies. These require, on an average, about 100 feet of lumber, board measure, per square set, which, at $11.00 per 1000 feet, would add for the lumber $1.10, and for placing it, say $0.10, or a total of $1.20 to each square sett, which would then cost, in the case of hand framing, $5.20, or a total cost of $0.21.6 per ton of crude ore; and in the case of machine-framing, $4.95, or a total cost of $0.20.6 per ton of crude ore.

INCIDENTAL COSTS.

The cost of timbering, per ton of ore shipped, would be greater than the figures given above in proportion to the quantity of waste or second-class ore that would be sorted out from the crude ore extracted.

In the Rossland mines about 20 per cent. of the ore mined is sorted out and goes to the second-class ore dump to await profitable treatment, expected to come in the future. Deducting 20 per cent. of the twenty-four tons of crude ore in a square set, there would remain 19.20 tons as the shipping ore, against which the total costs of the square set as above, $5.20 or $4.95 as the case might be, would have to be charged. This would raise the per tonnage costs on the ore shipped to about $0.27 and $0.26 respectively.

Where there is a reasonable expectation that the second-class ore will eventually pay a profit after suitable treatment, it would be only fair to charge a pro rated cost of the timbering to it, and the cost would then remain $0.20.6 and $0.21.6 per ton as above.

In cases where, on account of bad ground, angle bracing, bulkheading, or cribbing and filling would be required, the per tonnage cost would be still further increased, but to a comparatively small extent.

LIMITATIONS OF THE SQUARE SET.

The limit of the capacity of the square set system as already described without any reinforcing devices to withstand the pressure that may be exerted on it by the enclosing walls of an ore body when that ore body is extracted, may be reached.

This limit depends on the nature of the walls enclosing the deposit, and the extent of the excavation. If the wall rocks are solid and do not swell on exposure to the air and dip at a high angle, the ore body may be extracted between levels, say, 100 feet apart and for a length of 200 or 300 feet along the vein, and the pressure likely to be exerted by the walls will be sustained by the skeleton square set without reinforcement of any kind.

If, however, the vein dips at a low angle, and the wall rocks are decomposed, or of a talcose or serpentine character and disposed to swell, the pressure that might be exerted on the timbers, when even a comparatively small excavation of the ore body has been made, may cause them to crush, "jack knife," or collapse, allowing the wall rocks to cave in and close up the stope. When the members of the square set become squeezed out of the truly right-angled position which they should occupy, their capacity to resist wall pressure or strains from any direction is practically *nil.*

When, owing to wall pressure or imperfect erection of the sets, "jack knifing" of the square sets results, the cave-in, which sooner or later will follow, with disastrous consequences, may be prevented by either bulk-heading, cribbing, or filling the skeleton framework of the timbers.

The cost of the foregoing methods of reinforcement, which are the only practical ones that can be successfully used in bad ground, cannot be given with any general degree of accuracy, as that is so much affected by the local conditions in each case.

A general idea of what the cost is likely to be may be gleaned from the description following :—

REINFORCEMENT METHODS.

Angle-bracing.—If, after the square sets are properly erected in place, the members manifest an inclination to swing out of the right-angled positions they originally occupied to each other, this tendency may be arrested and prevented by a system of angle-bracing. This consists of placing diagonal braces made of round or square timber on the sill floor and against the foot of the posts, and leaning the heads so they will fit snugly against the top of the posts underneath the caps or girts, as the case may be, of the next adjacent set. The head of this diagonal brace should lean in the direction from which the pressure comes. This method is illustrated in Figure 8.

Cribbing.—When the square sets manifest a stronger tendency to swing than in the case referred to, the collapse threatened may be prevented by crib-work. This consists of crossing alternate layers of round or square timbers of any convenient size between the posts of the sets until the space between the sill and cap is filled, as shown in Fig. 9. This crib-work may extend from wall to wall through two or more rows of sets if required, and the spaces between the sets thus cribbed may be filled with waste rock, but this is called "Filling," and will be referred to under that heading below.

Bulkheading.—This method of reinforcement consists of placing timbers closely together in much the same way as the crib-work above referred to, and wedging them tightly between cap and sill.

Filling.—This method consists of filling the spaces between the members of the square set with any material such as waste rock, earth, or sand. When the filling is done it is retained within proper bounds, and the necessary passageways are kept open through the timbers by building crib-work around them as described.

Waste rock for filling purposes is generally secured from the development or dead-work that is being prosecuted in other sections of the mine, but where a large quantity is required, it is often found necessary to mine it specially for that purpose, or draw it from the waste dumps on the surface. About eight cubic yards of material is required to fill the vacant space of the frame of a square set, and the cost of such filling will be the cost of obtaining and placing such material, together with the crib work required to retain it within proper bounds.

GENERAL REMARKS.

The square set system of timbering is used successfully and exclusively in all mines where large deposits of metaliferous ores occur.

Where favorable conditions, such as railway transportation and a moderate supply of timber exist, it is comparatively cheap. If care is taken in the construction of this system in the mine, it ensures that all the ore existing may be extracted without injury to the workman or the

mine. Round logs or sawn timbers of any dimension, ranging from 8 inches upwards, may be used, but the sizes are governed by the economic conditions and mining requirements.

In the mines of Rossland, the round logs or timbers used for the square sets cost $1.20 for each log 16.5 feet in length f.o.b. the framing shed at the mine. These logs are cut in the State of Washington, and delivered over the Spokane Falls & Northern railway on flat cars, over distances ranging from 45 to 75 miles, each flat-car being loaded on an average with 60 logs. The unloading at the framing shed is done in a few minutes by cutting off the retaining standards on the flat cars, and allowing the logs to roll off on the storage platform.

Of course, where wagon transportation is required from the railway terminus, the expense will be correspondingly increased.

In every mining camp there will be more or less variation in the method of framing, and in the cost of the square sets in place, also in the tonnage of ore to be extracted from the space occupied by each square set.

Where the dip of the vein is at a flat angle or the walls are bad, shorter posts than those described herein will probably be more advantageous; the more vertical the dip of the ore deposit, the longer the posts may be, and *vice versa*.

Where sawn lumber is comparatively cheap, three-inch plank is preferable to lagging poles for floors, on account of the better floor it offers for shovelling, and the fact that it may be removed and re-used.

Safety Lamps and Colliery Explosions.

(Discussion of the paper by Mr. James Ashworth.)

By Mr. William Blakemore, Montreal.

There can be no doubt that the subject of safety lamps is of the greatest importance in connection with coal mining; possibly of greater importance than the regulation of blasting, with which it divides the attention aud interest of mining men.

The result of thirty years' experience, during which time I have tested every safety lamp which has been put on the market, leads me to the conclusion that the best result which can be obtained is only a certain percentage of safety, and of the lamps which approximate the closest to this standard I would specify the improved Hepplewhite Gray for testing processes, and the Mueseler. The former will, in my judgment, detect the presence of a smaller percentage of fire damp in the air than any other lamp, certainly than any other oil and wick lamp; and as long as this is the method of illumination I do not see how it is possible to construct a lamp mechanically more perfect than this. The fact that the only inlet is by way of the vertical tubes which admit air and gas at the top of the lamp and deliver them direct to the flame seems to me to give the maximum efficiency in this particular. I commenced to use the Hepplewhite Gray for testing purposes when it was first invented, and had have continued its use ever since; the only objection which has developed with experience is its liability to become extinguished by a sudden jerk, but this is a defect which it has in common with the best lamps, and can hardly be considered an element of danger. I have always found the finger-holes and slides upon the tubes of great value for testing purposes, and the proper manipulation of these renders the lamp as sensitive as can reasonably be expected for practical purposes.

With reference to the Mueseler, this lamp, when bonnetted, is as efficient and safe as any lamp with which I am acquainted for ordinary working purposes, and if used in combination with the more delicate lamp above referred to, furnishes a combination which I think meets the requirements of the case.

I am aware that the Wolf lamp is largely used in Pennsylvania and is growing in favor; it is a good lamp, but possesses one drawback which I consider fatal to all lamps of this class, viz., that it burns benzoline oil. The presence of a volatile oil in connection with a safety lamp is an added source of danger and will not long be tolerated in mines. I agree with Mr. Ashworth's remarks that the safety of a lamp is dependent, not upon ordinary conditions prevalent in a mine, but upon its ability to resist exceptional conditions which may be instantaneously produced, and this point must never be lost sight of, because the exceptionally dangerous condition may be produced at any moment and without the slightest warning. This is why all such lamps as the Clanny must be resolutely condemned, because although they may be perfectly safe under the normal conditions prevailing in a mine they become unsafe and highly dangerous in the presence of a sudden outburst of gas, an acceleration in the velocity of the air current, or the presence of a large quantity of coal dust.

As reference has been made in Mr. Ashworth's paper to the Fernie explosion I may be permitted to say that in my judgment the preponderance of the evidence adduced at the inquest pointed to the Clanny lamp as the undoubted origin of the explosion. This lamp was being used in immediate proximity to a feeder of gas, and at a point where, according to the evidence of the chief mine superintendent, the velocity of the air current was ten feet a second. After the explosion a lamp was found within a few feet of this feeder completely shattered, and although of course there can be no direct evidence on the point, the conjunction of all the elements necessary to produce an explosion rendered the matter one of easy natural deduction, especially as it was proven that the air was heavily charged with dry coal dust at this point. The behaviour of different lamps in a mixture of coal dust and air will undoubtedly form a subject for careful investigation, as hitherto the experiments made with coal dust have been more or less confined to testing its behaviour in the face of explosives; it may, however, be interesting to mention that in connection with the Fernie explosion one of the most experienced miners, Angus Ferguson, stated that he had frequently, when carrying a bonnetted Clanny in the works along the main haulage road where there was heavy coal dust but no gas, found the coal dust accumulate upon the lamp, and on shaking it slightly to get rid of the same a dull red flame would fill the lamp. The next question to solve would be—at what point this flame would connect with the outside of the lamp, and this is undoubtedly one of the problems of the times in connection with dry and dusty mines, because the conditions referred to prevail in so many.

My concluding remark must be an endorsation of Prof. Galloway's observation in his report on the explosion at the Universal Colliery, viz.: that recent occurrences lead to the irresistible conclusion that coal dust is relatively more dangerous in a mine than fire damp.

By Mr. W. D. L. Hardie, Lethbridge, Alta.

During many years practical experience in bituminous coal mines, both in America and Europe, I have paid much attention to modes of working and the dangerous elements that enter into the practice of coal mining. I have found in nearly all, if not every one of the superior coking coals, which lie comparatively flat and not much faulted, whether marsh gas be present or not that the dust has a more or less marked "greasy feel," indicating that in addition to the carbon there must be some of the heavy hydro-carbons of the paraffin series present in the volatile matter. When such a seam gives off fire-damp the damp is very likely to be "sharp," indicating that hydrogen, as well as the heavy hydro-carbons, is likely a constituent of the fire-damp.

Under these conditions, which, I think, from personal examination, hold good at Fernie, B.C., the inflammable point of the explosive gas given off is very much lower than that of ordinary fire-damp. Under such conditions the explosive point is reached with a less per-

centage of gas, and of course the quantity of the gas to give the maximum explosive force will also be much less in the explosive mixture. If the Fernie coal dust carries a small percentage of heavy hydrocarbons or free hydrogen, it can be readily imagined how easily the dust could be raised to an incandescent heat and the hydro-carbons distilled in quantities large enough to cause an explosion of any magnitude, if plenty of coal dust has been deposited in the mine, having its initial cause in the ignition of a small quantity of gas, or from many other causes, even if explosive gases were not present in such quantities as could be detected with the ordinary, or even improved safety lamps. By improved safety lamp I do not mean those specially designed for delicate work.

Under these circumstances it is of the utmost importance that the smallest percentage of gas should be detected, but it is just of as much importance that all the other dangers should be known and cared for. For years I have used the Ashworth-Hepplewhite-Gray lamp in several forms, including Clow's hydrogen flame, the Pieter lamp without and with Garforth's rubber ball, and Shaw's gas-testing machine, with singularly good results. To the use of these appliances and a fairly good knowledge of gases, and a good grasp of "the hydro-carbon in coal dust" theory I attribute my success, in over twenty years practical experience, in avoiding accidents in some of the most gaseous, dry, and dusty mines on this continent. In one colliery which exploded before I took charge I had the greatest difficulty for a long time in instilling into the officials' minds the great necessity of getting a complete knowledge of "the hydro-carbon in coal dust" theory, but was successful in avoiding accidents while I remained there. Since then there have been several minor explosions, and one very large one, killing over 100 men, dating not more than six months back.

I do not think that the coal dust theory should ever be lost sight of in mines where the volatile constituents form any considerable percentage of the analyses. In anthracite mining the problem is not so difficult; in such seams the danger is mostly, if not altogether, marsh-gas. The South Wilkes–Barre Colliery, Pennsylvania, U.S.A., is perhaps the most fiery colliery in the United States, as much as three and four per cent. of fire-damp being detected almost constantly in the fan drift by the Shaw gas tester, but there the problem is not a partticularly difficult one, because there is no dangerous coal dust, no element not well understood.

By far the largest number of explosions on the American continent take place in dry and dusty bituminous coal mines, some of which gave off firedamp, while in others that have exploded never a sign of fire-damp has been seen on a safety lamp, yet the lives lost in each of these mines count up in hundreds. In many of them I am sceptical as to whether there was any gas given off. I trudged round the East mine of the South-west Virginia Improvement Co., Pocahontas, Va., and worked at the coal for over six months after the explosion there, in the vain hope that I would be able to find something that would indicate that there was some marsh grass present, but I never saw it. In the presence of several officials of the company and Andrew Roy, then the chief mine inspector for Ohio, I fired a heavy shot in a wide room where the coal was mined at least five feet deep. After such a shot a long tongue of red flame invariably shot out from twenty to thirty feet, and if the coal came down, flame at white heat played around behind the coal, in many cases dying out gradually, the last small flame presenting the blue cap. This only supported my idea of the distillation of the hydro-carbons in the coal dust. I have seen the same phenomena in most seams of a good coking quality. If marsh gas be present, forming a mechanical mixture with air, the phenomena will be intensified.

From the foregoing remarks it will be seen that I am not one of those who believe that it is necessary to have a percentage of marsh-gas present before we can have a "coal dust explosion." But woe will surely betide the manager who has both coal dust and gas present if he does not carefully take care of both with the most advanced knowledge of the day. I would not think of being in charge of any dry and dusty mine without endeavouring to detect explosive gas with the most improved safety lamp or other detector known to the mining fraternity, even if in my mind I thought there was no possibility of gas being present: one can never tell.

Even if it be admitted that gas must be present before a "coal dust explosion" can take place, "the enquiry into the Seaham disaster in 1880 showed that the presence of two and one-half per cent. of fire-damp in a dry and dusty mine created an atmosphere which would in the presence of a blown-out shot, over-powdered shot, or a badly placed shot, bring about a fearful disaster." There are not so very many who can detect even three per cent. of fire-damp with the ordinary safety lamp. Of course there are lots who think they can, but can they?

Where gas, coal dust, or both are present in a mine it is the duty of the manager to know all that is knowable about the dangers connected with the same so that he may do the best to protect the lives of the men intrusted to his guidance and protect the company's valuable property from damage or destruction.

It is a well known fact that increased temperature reduces the temperature of ignition and that a low barometer reduces the violence of a gas explosion, but these are factors of small moment where coal dust is one of the elements when looking into the mechanical effect of an explosion; but in the case of gas detection, increase in temperature and reduction of temperature (low barometer) may be of considerable importance.

Another point, I will mention in passing, is that the effect of coal dust on the flame of a testing lamp is not generally given the consideration it should have by the fire bosses and other officials in dry and dusty mines, on this continent. Here is another opportunity for the distillation of explosive gases on which I have laid so much stress. Coal dust in contact with the flame of a testing lamp is a condition that might well be made the subject of a scientific paper. Coal dust in the meshes of the gauze of an ordinary safety lamp becomes incandescent almost instantly and passes the flame to the mixture outside of the lamp.

Mr. Ashworth's lamp is simply an improvement on the Gray lamp, which had the good fortune to be highly recommended by the Royal Commission, and there is no doubt but it is a good lamp; however, it has not passed through its course without considerable objection being raised to it by many able mining engineers and mine managers in Great Britain. As recently as the years 1892-3 Mr. Stokes and Messrs. Ashworth and Clowes had considerable controversy as to the relative merits of the Stokes and the Ashworth lamps. From the discussion that followed I gathered that both lamps had about an equal number of supporters, but all seemed to be unanimously of the opinion that both lamps were good and capable of detecting equally small percentages of gas, but the Stokes lamp had the advantage of using alcohol instead of hydrogen gas used in the Ashworth lamp then under discussion. Both lamps use oil for testing for over 2½ per cent. of gas.

Mr. Ashworth in his paper does not discuss the percentage of gas his lamp will detect, but satisfied himself with saying that "it will detect more readily and with greater certainty the presence of the blue cap than any Davy lamp which was ever made." This is definite, but not very informative, and presupposes a knowledge not had by all who will read his paper.

Mr. Ashworth's paper is a valuable one; if it will induce the mine managers and mining engineers in Canada and the United States to give safety lamps and other subjects in coal mining the thought they deserve, by giving the chase for cheap coal just a little less attention, it shall have served a good purpose.

Mine Signalling by Compressed Air.

By Bernard MacDonald and Wm. Thompson, Rossland B.C.

In mining operations the problem of signalling from the mine workings to the engineer running the hoisting engine on the surface is receiving more thought than formerly. This is due to the rapidly increasing depths of mine workings, and to the fact that the devices now in general use render signalling from considerable depths unreliable.

The system in general use is known as the pull bell system. The mechanical appliances used in this system consist of a marine gong or other sounding apparatus, called the bell, a rope, called the signal rope, a device for deflecting the direction of the signal rope, called the bell crank, and a counterbalance for the weight of the signal rope, called the balance bob.

The bell is located in the engineer's room, or within ear-shot, and generally within convenient sight of the engineer.

The signal rope is attached to the bell and carried to the collar of the shaft, thence down it to the deepest workings from which it is desired to transmit signals to the engineer at the surface.

The bell crank is a triangular lever, placed at the collar of the shaft, or at any other place, where the direction of the signal rope is changed.

The balance bob is placed at the collar of the shaft, or at suitable distances apart in it, to balance or slightly overbalance the weight of the signal rope. It is fulcrumed as a beam, the signal rope being attached to one arm, while the other arm is weighted as mentioned.

Balance bobs are sometimes substituted by spiral or coiled springs to produce the same effect.

The signals for hoisting or lowering men or material, or telling what is wanted by the workmen below are given by the bell, in the form of strokes and pauses in singles or in any alternating series or combinations conformable with the code used.

The signals are transmitted from any level in the mine by pulling the signal rope, as the signal code requires. The arms of the bell crank, to the ends of which the signal rope is fastened, extend outwards from a fulcrum pivot at right angles to each other.

In the case of an incline shaft the arms of the bell crank radiate from the fulcrum pivot at an angle to each other equal to the angle the dip of the incline shaft makes with the horizon.

A convenient combination bell crank and balance bob is often made in one piece. The balance bob and the bell crank extend as little as is necessary into the shaft, and are boxed in as securely as the conditions will admit, in order to prevent accident in case of pieces becoming loose and falling down the shaft.

The signal rope is preferably a wire one, but plaited cotton or hemp rope is of common use. Twisted rope is not suitable on account of the alternate stretching and shortening that would result from the pulls necessary to transmit the signals.

The signal rope is kept from sagging or swinging into the shaft by staples or other fastenings driven into the timbers in the corner of the shaft.

The balance bobs are so weighted as to overbalance by some 10 or 15 pounds the dead weight of the signal rope. Overbalanced thus, unless interfered with by some other causes, the signal rope returns promptly after each pull to its normal position in a state of rest. This device facilitates and makes possible the transmission of signal strokes to the bell at the surface from the workings of the mine.

Separate installations similar to that described are made for each shaft compartment through which hoisting is to be done, and to avoid confusion to the engineer, or mistakes, the gongs or sounding apparatus on the surface have different tones, and are frequently placed at considerable distances apart, and toned in this way the engineer is less likely to mistake from which compartment the signal was transmitted.

SIGNAL CODE.

That which remains yet to be said about the pull bell system of signaling may be better understood, one of the signal codes in common use is given below for reference.

General.

1 Bell, hoist.
1 " stop, is in motion.
2 Bells, lower.
3 " warning that men are going aboard, and that the cage is to be hoisted or lowered according to the signal to be given subsequently.

Station Signals.

2 Bells, pause;	2 bells, pause;	2 bells, to station at surface.
1 Bell, "	1 bell,	to station at 1st level.
1 " "	2 bells,	to station at 2nd "
1 " "	3 "	to station at 3rd "
2 Bells, "	1 bell,	to station at 4th "
2 " "	2 bells,	to station at 5th "
2 " "	3 "	to station at 6th "
3 " "	3 "	to station at 7th "
4 " "	1 bell,	to station at 8th "
4 " "	2 bells,	to station at 9th "
4 " "	3 "	to station at 10th "

DEFECTS OF THE PULL BELL SYSTEM.

When the mine workings are shallow and there is but one or two hoisting compartments, the pull bell system of signaling works very well, but when any considerable depth is attained or where there is more than one hoisting compartment and the traffic is heavy and from various levels, the defects of the system become apparent.

The primary cause of most of the defects is the fact that all the parts of the apparatus are moving parts, having to reciprocate to each other for every pull given by the signal sender. It will be readily understood how an apparatus constructed with a large number of reciprocating parts extending through vertical or inclined shafts to depths of over 1000 or 2000 feet may become deranged and out of order.

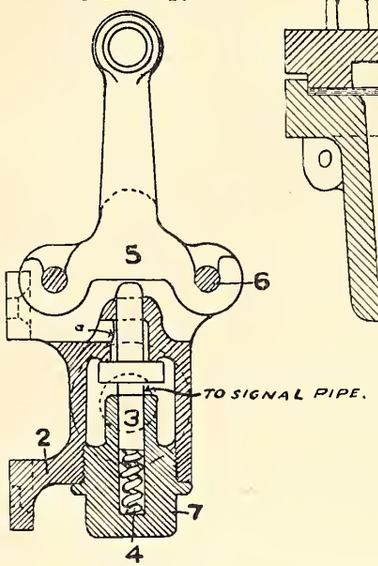
One of the greatest defects of the system is that the signal sender cannot know whether the signal he sent to the engineer has been properly transmitted and reported by the bell, as the bell strokes cannot be heard at any considerable depth in the mine. Then, at any time one or more of the numerous parts of the apparatus may become deranged and cease to work during the transmission of a signal, and the part of the signal sent before the derangement occured may, in itself, be a complete signal, conveying to the engineer an entirely different signal from that which was intended. If the erroneous signal thus received be acted upon by the engineer, an accident to life or machinery might result.

Again, the apparatus might become deranged by expansion or contraction of the signal rope. In the case of a wire rope this might result suddenly from the rise or fall of temperature in the shaft due to change of air currents in the shaft from an upcast to a downcast, or *vice versa*. In the case of a cotton or hemp rope, the alternate wetting and drying, not uncommon in shafts, would have the same effect. The devices for fastening the balance bobs or for retaining the signal rope in one corner of the shaft are liable to become broken or destroyed by wear or accident, and the rope sag or swing into the shaft, where it would be likely to be caught and carried away by the ascending or descending cages. The numerous defects to the pull bell system of signaling mentioned become more accentuated when the system is operated through an incline shaft.

On account of these defects, a number of electric signalling systems have been devised, from time to time, and tested. While some of these have shown considerable merit, in certain ways, over the pull bell system, nearly all of them demand the use of apparatus too delicate for the rough usage and conditions inseparable from mining

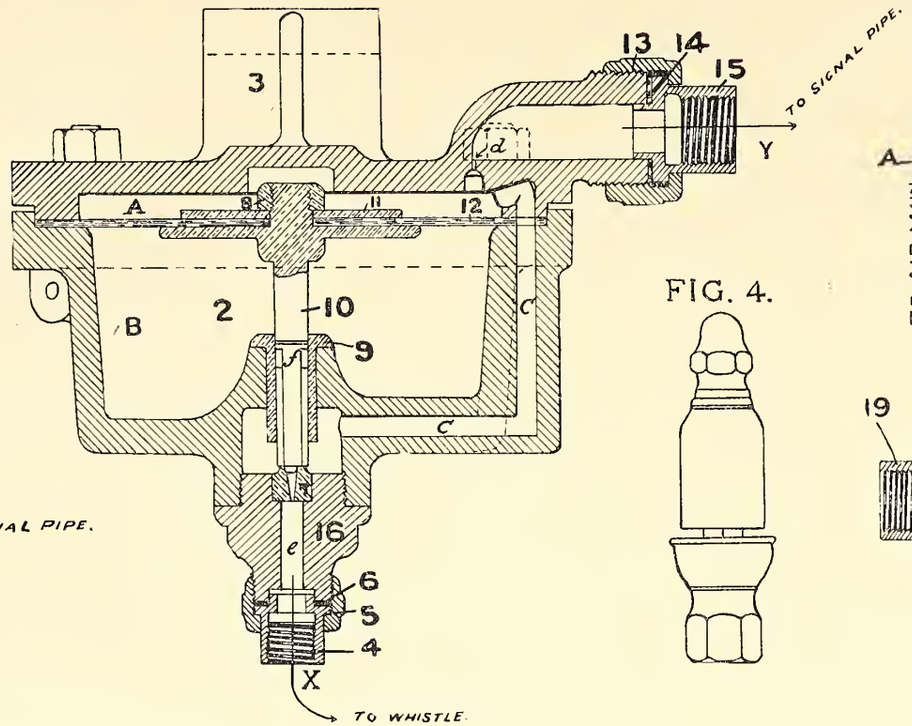
MINE SIGNALLING BY COMPRESSED AIR.

FIG. 1.



DISCHARGE VALVE.

FIG. 3.

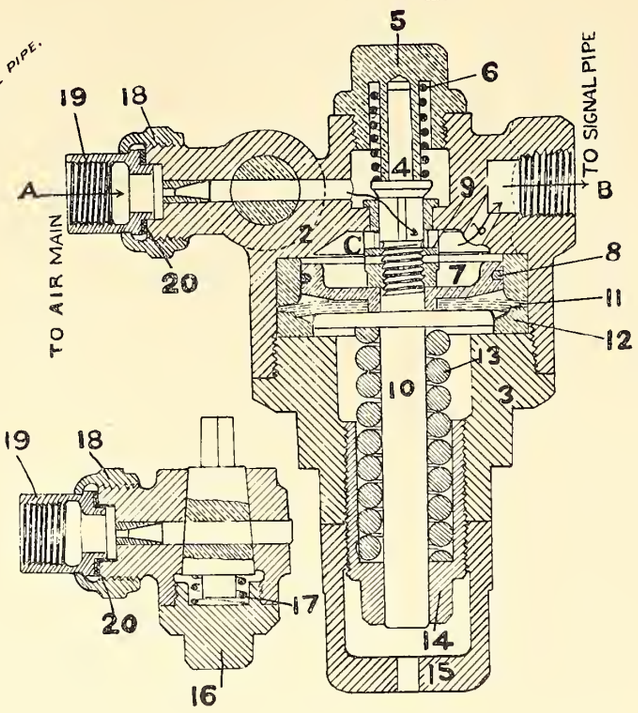


SIGNAL VALVE.

FIG. 4.

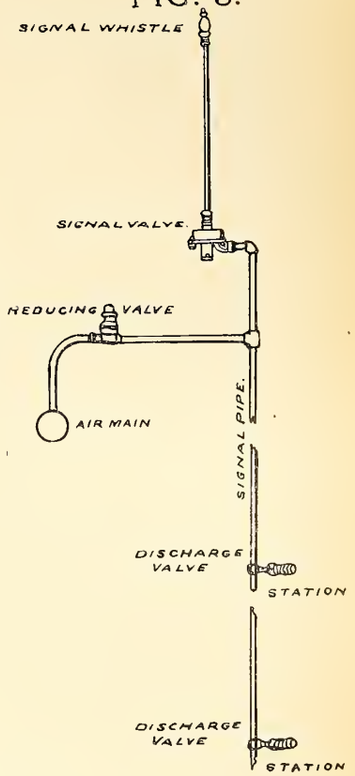
SIGNALWHISTLE

FIG. 2.



REDUCING VALVE.

FIG. 5.



Illustrating paper by Messrs. Wm. Thompson and Bernard MacDonald, Rossland.

operations. These reasons and the lack of simplicity of construction which permits of extension, maintenance and repairs of the apparatus by men lacking technical training constitutes a serious defect in the otherwise best of the electric systems.

The defects of the pull bell system became painfully apparent to the writers when they undertook the installation of a signalling system in each of the four hoisting compartments of the Le Roi combination (incline) shaft. If the pull bell or electric systems were installed, the four bells representing the four compartments would have to be in the room with the two hoisting engines. With the possibility of four bells ringing at once, confusion and mistakes would be inevitable. In devising ways to overcome this difficulty, it occured to us that since the signalling between the conductor and engineer of express trains is now carried on most satisfactorily by compressed air, it would not be more difficult to obtain equally good signal service by the same system through the combination shaft.

With this object in view, correspondence was opened with the Westinghouse Air Brake Company, of Philadelphia, the patentees of the air system used on trains. Being informed that the apparatus of that system was obtainable, and of moderate price, it was purchased and installed in two of the compartments of the combination shaft, in the month of February, 1900. The system was a success from the start, and has been in continuous operation ever since, giving perfect satisfaction without any expense for maintenance or repairs. Recognizing its superiority over the pull bell system described, and believing that its adoption where the circumstances are suitable will add another improvement to mining equipment, the following detailed description of the apparatus and its cost is given.

THE COMPRESSED AIR SIGNAL SYSTEM.

The apparatus of this signalling system is the same as that used by express trains, with some slight modifications in the installation. Fig. 1, 2, 3, 4, and 5 accompanying show the details, of the apparatus used, all of which may be purchased from the Westinghouse Air Brake Company.

The *Whistle*, Fig. 4, is the sounding device which conveys to the engineer the signal sent from the mine workings. This is located in the engine room, and where signals from more than one source are received each whistle may be tuned or chimed differently from the other, so the engineer may readily distinguish the source from which the signal is sent.

The *Signal Pipe*, Fig. 5, is ½ or ¾ inch in diameter, and must be used exclusively for signalling purposes. It connects with the whistle down to the deepest workings in the mine. Signalling apparatus may be fitted in this pipe at any intermediate points desired. In fitting this pipe care must be taken that no leaks exist, for the smallest leak would destroy the working of the system.

The *Signal Valve*, Fig. 3, must be placed at some point in the signal pipe where there is no danger of freezing—close to the hoisting engine would, perhaps, be most suitable. This part of the apparatus consists of a mechanical device containing two compartments "A" and "B", separated by a diaphragm 12, and the diaphragm stem 10, attached thereto extends through bushing 9, its end forming a valve on seat 16, over port (e.)—a small portion of the diaphragm stem 10, fits bushing 9, snugly, while just below its upper surface a peripheral groove is cut in the stem and its lower end is milled in triangular form, signal valve is attached to main signal pipe at Y, where pressure enters, and passing through port (D) charges chamber "A" and through port C, past stem 10, charges chamber "B".

A sudden reduction of pressure in the signal pipe reduces the pressure on top of diaphragm 12, in chamber "A," and the greater pressure in chamber "B" acting on its under surface forces diaphragm upward and momentarily permits portion of the air in the signal pipe and chamber "B" to escape to the whistle, thus sounding a signal to the engineer as often as the discharge valves are opened at any one of the stations.

The *Reducing Valve*, Fig. 2, is inserted in the feed pipe that connects the compressed air mains of the mine with the main signal pipe of the system. The regular mine pipes should be connected by suitable piping at outlet "A," and other piping extend from outlet "B" to the signal pipes, in which the maximum pressure should be 40 pounds per square inch. As this pressure is reduced by signalling, piston 9 rises under pressure from spring 13, and forces supply valve 4 from its seats, when pressure from air mains entering at "A" passes through valve 4 to chamber "C" and through port (b) to the signal pipe at "B." The pressure therein being restored to 40 pounds, piston 7 is forced downwards by air pressure and valve 4 is seated by spring 6, shutting off further supply of air until another signal has been sent, releasing pressure contained in signal pipe.

The *Discharge Valve*, Fig. 1, is inserted in the signal pipe in close proximity to the signaling station so the sibilant sounds of the air discharges may be easily heard by the signal sender. The importance of this lies in the fact that the discharge sounds give assurance that the signal has been delivered to the engineer on the surface. A branch pipe should extend to the main signal pipe and a valve set between the discharge valve and main signal pipe, to permit repairs being made to discharge valve at any time.

A moderately light cord should be attached to the discharge valve at lever 5, and extended to within easy reach of the operator.

With each pull of the cord lever 5 pushes open valve 3, permitting a small quantity of air to escape from the signal pipe, and causing the signal to be transmitted to the engineer in the manner described.

COST OF INSTALLATION.

The apparatus required in the engine room consists of

1 Small whistle, Fig. 4, cost	$1 25
1 Reducing valve, " 2, "	4 50
1 Signal valve, " 3, "	6 00
Total cost	$11 75

The entire cost of an installation to a depth of 1,000 feet, with signaling stations 100 feet apart would be $127.50, made up of details as follows:—

Engine room part of apparatus, as above	$11 75
Sufficient ¾" pipe to connect from engine room to collar of shaft—say 100 ft	5 00
Labor installing (1 day, fitter and helper)	6 50
11 Discharge valves, located one at collar and one at each working station, cost each $2.00	22 00
11 ¾" Common globe valves, 75c. each	8 25
1,000 feet of ¾" common iron pipe	50 00
50 Wrought iron hangers, 5c. each	2 50
Labor installing (1 fitter, 2 helpers—2 days)	19 00
10 pounds ¼" dia. cotton bell cord, at 75c	2 50
Total cost of equipment ready for service	$127 00

OPERATION.

Signals are given the engineer from any station or signaling point in the mine workings by a quick short pull of the signal cord attached to the lever of the discharge valve. Such pulls momentarily reduce the pressure in the main signal pipe and transmit an impulse on the column of air contained therein, the effect of which is to automatically operate the signal valve and discharge a small quantity of air through the whistle, sounding a sharp, clear blast, corresponding to each pull of the cord. Each whistle blast in the engine room is represented by a sharp discharge of air from the discharge valve, which gives to the signal sender the means of accurately checking the signal sent in.

Signal blasts may be given at the rate of two per second,—in fact this rule should be generally observed, as long discharges of air at the

signal valve are not only unnecessary, but likely to confuse the engineer.

In case the supply of compressed air is likely to be shut off at any time, this system might be supplemented with the pull bell, or some of the electric systems of signaling.

THE ADVANTAGES OF SIGNALING BY COMPRESSED AIR AS COMPARED WITH THE PULL BELL SYSTEM.

In the apparatus for signaling by compressed air there is only one moving part, viz., the lever of discharge valve, whereas in the pull bell system all the parts are of the necessity moving parts, being obliged to reciprocate to every pull of the signal rope given by the signal sender. The advantage lies obviously with the apparatus having the least number of moving parts, as every moving part is subject to wear and disorder, which is costly to maintain and repair, and unreliable in operation.

Another very important advantage with the compressed air system, is the fact that the signal sender has always the means of knowing whether the signal sent by him has been delivered to the engineer. Changes of temperature, likely to occur from change of air currents, do not effect the working of the system. If any accident should injure the signal pipe or any other of the apparatus of the system, warning would be given at once to the engineer, so the injury could be rectified at once.

In the matter of costs for maintainance, the compressed air system has undoubted advantage of any other system. This system has been established and in operation for about 17 months at the Le Roi Mine, and during this time has required no repairs whatever.

Mineral Resources of Vancouver Island.*

By W. M. Brewer, M.E., Victoria, B.C.

The mineral resources of Vancouver Island comprise coal, gold ores, copper gold ores, a little galena, and magnetite. Although the first discovery in coal was made on the east coast of the island as early as 1835, no systematic work of prospecting or developing was commenced until 1849, when the Hudson's Bay Company brought a party of coal miners from Scotland and commenced work at Suquash, a point on the coast near Port McNeil and semi-distant between Alert Bay Harbour and Hardy Bay. About 1852, the Company abandoned work at this point and commenced mining for coal on the present site of the City of Nanaimo. In 1862, that portion of the coal field together with the coal on Newcastle and other nearby islands was sold to the New Vancouver Coal Company. It was about this time that the late Honourable Robert Dunsmuir, who had been in the employ of the Hudson's Bay Company during their operations, resigned from their employ and started to prospect for coal fields on his own account. The first locations he made were the Harewood mines, which he sold to an English syndicate and which are at present being worked by the New Vancouver Coal Company. About 1869 or '70 Mr. Dunsmuir discovered the Wellington seam on the Nanaimo River and secured from the Imperial Government—previous to the entry of British Columbia into the Confederation—the tract of coal-bearing land which laid the foundation to the large fortune which that gentleman acquired before his death. The shipment of this coal to California ports is directly responsible for the partnership which was entered into later between the late Mr. Dunsmuir and Messrs. Huntington, Stanford, Crocker and Hopkins, the *Big Four* of the Southern Pacific, which partnership resulted in the building and equipping of the Esquimalt and Nanaimo Railway, and opening of the Northfield, Extension and Union Collieries. The foregoing is a brief history of the beginning of the coal mining industry on Vancouver Island.

The history of metalliferous mining commenced with the discovery of placer gold on the Leech and Sooke Rivers about 25 miles from Victoria in 1860, and during the big rush to the Cariboo Placer Mines. These discoveries were succeeded later by others on the China and Granite Creeks which empty into Alberni Canal as well as on Bear River, which empties into Bedwell Sound, on the west coast of Vancouver Island. It was not, though, until 1893 or '94 that any further attention was given to prospecting for other than placer gold and it was really not until the commencement of the Klondike excitement that any really serious efforts were made in prospecting even the coast-line on the western side of the island. Since then gold-bearing quartz, partially free-milling, copper ores and iron ores have been discovered on the west coast occuring in zones, having a general trend to the north-west, as well as copper-gold ores in the south-eastern portion of the island on Mounts Mallahat, Skerrit, Sicker and Brenton.

Geology.—Roughly speaking the geological formation of Vancouver Island can be divided into three separate classes of rocks, viz.:—Cretaceous sandstones, and shales in which occur the coal measures, a belt of semi-crystalline slates, and Dawson's Vancouver series, which according to his classification embrace the igneous and metamorphic rocks together with the crystalline limestones. The latter is considered by the same authority as probably belonging to the carboniferous period.

If a map of the island is consulted, the areas covered by these different formations are found to be as follows:—

Around Victoria and the extreme south end of the island, rocks of the Vancouver series, north from these and occupying a belt extending from Saanich Inlet across the island to the Gordon River and San Juan Harbour occurs the belt of semi-crystalline slates and schists in which are found a considerable quantity of graphitic slates. Northerly from this and extending along the east coast are the cretaceous coal measures with occasional breaks occupied by rocks of the Vancouver series. West from the coal measures, the island so far as is known is made up of rocks of the Vancouver series except a narrow fringe of sandstones, shales and conglomerates, possibly belonging to the Tertiary period, along portions of the shore line of the west coast.

No thorough geological survey having ever been made of the island it is very difficult to particularize and give other than a rough and approximate idea of the general geological features. Several geologists, mining engineers and prospectors, as well as the writer, have made notes on various sections, but as all of these are separated from one another by miles of intervening rock, of which absolutely nothing is known, the conclusions drawn are necessarily only vague. For instance, the Sooke mountain range is made up of a semi-crystalline slate and schists with stringers of quartz, which often widen out into lenses of some 3 or 4 feet in width and 40 to 50 feet in length interfoliated conformably with the general strike and dip of the formation, which has been traversed by several streams, among them the Leech, Jordan, Gordon and San Juan rivers. Consequently the writer has assumed that this zone or belt of formation extends across the island, although the middle portion of it, from the head waters of the Leech River on the eastern side to the head waters of the San Juan on the western side has never been actually visited by him.

As a matter of fact there is a very large portion of Vancouver Island even to-day which has never been explored by white men, and it is less likely to have been by the Indians because all the tribes occupy rancheries or reservations on the coast lines, devote their time to fishing and sealing, as they very much prefer travelling by canoe or boat to climbing mountains and pushing their way through the sallal or other underbrush with packs on their backs. For this reason but little information can be gathered from the aborigines, who, as a rule, in most of the western country have explored extensively previous to the invasion by white men.

There is a certain regularity about the mineral-bearing zones on

*Read before the September meeting of The Canadian Mining Institute.

the west coast; for instance, the zone in which non-cupreous magnetite occurs is situated nearer to the coast line than the zone carrying copper ores; while the zone in which gold-bearing quartz is found lies to the north-east from that in which copper ores are found

The geological and mineralogical features of Vancouver Island, so far as the observations of the writer go, present many very interesting, complicated and to a great extent, unique characteristics.

While the zones of country rock have some regularity as regards strike and dip, yet the results from eruptive action have been such that extensive and innumerable faults are encountered which add to the complications in prosecuting development work. There are no leads in the general acceptation of the word. The ore bodies are composed principally of lenses occurring either at the contact of igneous dykes and limestone or else in fissures in the igneous rocks or as lenses in schistose rocks. The characteristic fissure veins of Colorado are, so far as the writer's observations have extended, entirely wanting on the island. While it is true that you can in many instances follow an outcrop from point to point for distances varying from 200 to 1,000 feet, yet development demonstrates that the so-called lead is made up of lenses lying *en eschelon* to each other and usually having a pitch in a different direction to the dip. In following such ore bodies down it has been found that they possess similar characteristics in a vertical direction to those in a horizontal direction. Consequently, before the engineer is thoroughly competent to prosecute development work on the island, he should make a very close study of the geology and of the results from development work on neighbouring properties, otherwise he is liable to make mistakes which he will regret.

One of the features peculiar to Vancouver Island is the heavy outcroppings of hornblend which contains so great a percentage of iron that the surface has the same rusty ochreous appearance as is found in the regular gossun outcroppings, but on being broken into it is found that this apparent iron capping is only a thin scale underlaid by hornblend crystals, many of which are undergoing the evolution which alters the hornblend into asbestos and closely associated with which are crystals of iron pyrites. Another is, that there is practically no oxidized zone, but the unaltered sulphides of copper occur immediately under the surface; in fact the writer has found crystals of copper pyrite which showed by assay as high as 24 per cent. copper within a foot or two of the surface and enclosed in a mass of magnetite. Garnet rock and epidote are usually found associated with the magnetite and copper deposits on the island, as gangue material and forming ledge matter.

The question of origin of the ore deposits is one which will interest geologists and engineers very much. Apparently the magnetite is the resultant from the basic igneous rocks and illustrates Posepny's theory, but the question has been propounded as to whether these rocks are sufficiently basic and whether or not the deposition of the magnetite is due to some other cause.

Posepny, in his treatise on the "Genesis of Ore Deposits," has the following paragraph, viz.: "As to the eruptive rocks we do not know what they once were, as we study them only from the moment of cooling. But we observe at once that iron—a metal widely distributed in all deposits and in nature—generally occurs primitive in these rocks in the form of magnetite, a mineral of striking metallic appearance."

Felsite is found very frequently in contact with the crystalline limestone and the igneous rocks. This felsite apparently occurs in dikes as intrusions, and a close examination of the formation where such dikes occur suggests the probability of movements at different periods and the possibility that the felsite intrusions belong to an older period than the intrusion of the other igneous rocks, and also that the ore bodies are more closely associated and have been more thoroughly influenced by the intrusions of the felsite than of the other igneous rocks in locations where the ore occurs as contact deposits, but where the ore fills fissures in the diorite or diabase the writer has noticed the absence of felsite and also the fact that the magnetite with the associated chalcopyrite does not apparently maintain continuity to any great depth, but that both classes of ore give out simultaneously. Evidently the chalcopyrite has been deposited by the infiltration of copper charged waters through crevices and porous places in the magnetite, and it is very questionable, in the opinion of the writer, whether these fissure ore bodies will possess any great value as compared with the contact bodies and the lenses in the schist formation. In the two latter occurrences but little if any magnetite is noticeable associated with the chalcopyrite.

One peculiar characteristic which is generally noticeable with regard to the ore bodies which fill fissures in the igneous rocks is that there is only one well defined wall instead of both walls being well defined as in the general run of fissure veins in Colorado, for instance. As a matter of fact the fissures in the igneous rocks on Vancouver Island appear to approach more nearly to the cleavage planes of faults in which the work of replacement has been progressing until ore bodies of variable width and of lenticular structure have been deposited. The change from solid ore to barren country rock has been gradual. These conditions are noticeable in very many of the ore bodies occupying these so-called fissures. Often, too, when the ore has given out entirely the one wall remains perfectly good with a coating of calcite varying in thickness from several inches down to a knife-blade as a parting between the wall and the country rock. Narrow seams of calcite will often be found extending into the country rock on both sides of the wall and filling fractures. These fractures, and indeed the fissures in which ore bodies are found, in the judgment of the writer, are merely contraction joints caused by the cooling of the igneous rocks from a molten condition.

Economic Features.—Those portions of the island which are actually productive at the present time naturally possess a greater interest than the non-productive, and it is these which the writer will discuss in the present paper rather than the sections in which, although mineral has been discovered, locations made and prospecting work done, are still in a non-productive stage.

Starting from the south end of the island the first productive district is Skerrit Mountain, where in 1897 was made one of the first locations of copper-gold ore recorded on the island. The ore body has a maximum width of about 4 feet and occurs in shoots. The one on which most development has been done is 90 feet in length. The ore mined from it to a depth of about 60 feet was shipped to the Tacoma smelter during the year 1900 and yielded from 12 to 15 per cent. of copper and about 7 ounces of silver and a dollar in gold to the ton. This ore body occurs in a metamorphosed slate, in which occur dykes of eruptive rock and the ore body apparently fills a space between these two varieties of rock, in which also has been deposited a considerable thickness of quartz; so that, frequently, the quartz ledge-matter is found unaccompanied by ore, but at other times the solid ore occupies the entire space. A series of faults have been exposed during the progress of development work, through which the ore body is thrown several feet horizontally; consequently, to a casual observer there are apparently three or four distinct leads, when, as a matter of fact, the conditions indicate the system of faulting as described by the writer.

The next productive portion of the island is that known as the Mount Sicker District, in which are located the "Lenora," "Tyee," and other mineral claims. Of these, the Lenora has shipped in all about 35,000 tons of ore, and in the Tyee the management report 60,000 tons blocked out. The character of this ore is chalcopyrite in a baryta, garnet, quartz and iron pyrite gangue. The grade averages about $5.00 per ton in gold; 5 per cent. (dry) in copper, and variable silver values.

These ore bodies are lenticular in structure and occur interfoliated between schists, with their lines of strike conformable to the schistosity of the rock, but apparently not conformable to the original bedding-

planes. The schistosity has been caused apparently through shearing movements, resulting from the intrusion of dykes and convulsions of the earth's crust. The schistose rock is so altered as to make a microscopical examination by experts necessary before it can be properly classified; the igneous dykes in some instances have porphyritic structure, in others resemble diabase. The occurrences of ore are, so far as the writer's observations have gone, confined to the sheared zone, and where the rocks are massive, or even at the contact of the massive dykes and the schistose rock, ore bodies do not occur This condition, though, may not be a general rule, but may prevail only at such points as have been examined by the writer.

During the early development stages of these properties, the writer was severely taken to task for expressing the opinion that the ore bodies were lenticular in structure instead of occupying a continuous lead and maintaining unbroken continuity to some undetermined great depth. But the development work done up to the present time has demonstrated clearly that the writer at that time described the structure of the ore bodies accurately as such has been since determined by actual work.

The sheared zone in this district is of, as yet, undetermined extent; longitudinally it maintains continuity through Mt. Sicker, across the Chemainus river, and westerly through Mt. Brenton. The trend, or line of strike, of this zone is to the west, while the general trend of the country rock of the island is north-westerly. It is quite possible that this zone of schistose rocks has merely local limitations, because the Alberni Canal traverses the westerly portion of the island for some 28 miles, and if these schistose rocks maintained continuity in a westerly direction, this canal ought to crosscut the formation; but, if such be the case, the fact has been unobserved by the writer, notwithstanding that he has made several expeditions along both shores of the canal—which, however, does crosscut a copper-bearing zone, the rocks composing which, though, suggest a different geological formation. The Mt. Sicker formation also occurs on the north side of Maple Bay, on the east coast of the island, but in that locality the belt of schistose rocks is apparently of very much less extent in width than on Mts. Sicker and Brenton.

Travelling northerly from the Mt Sicker district, the coal measures are met with within a comparatively short distance, and so far as the extreme eastern coast of the island is concerned the crystalline rocks do not again appear, except in limited areas around Nanoose Bay and a strip along the shore line of Discovery Passage and Johnstone Strait. It is along that portion of the Eastern Coast from Oyster Harbor—a short distance north from Mt. Brenton—to Comox Harbour, a distance of about 75 miles, that the productive coal mines are located. From these have been exported for several years an average of about a million tons of coal per year; in fact the chief market for the total output of these mines has been California. There are collieries located at Extension, about 10 miles west from Oyster Harbour; at Alexandria, about 10 miles north of the Harbour; at Nanaimo and Harewood, 15 miles north from the Harbour; at Wellington, about 6 miles north-west of Nanaimo, and at Union, about 11 miles inland from Comox Harbour. All of these collieries, with the exception of the original Wellington Colliery, are producing bituminous coal to-day and a good quality of coke is being made at Comox Railroad. Connection between the collieries and salt water have been established for several years past. The coal industry alone has built up the flourishing towns of Nanaimo, on Nanaimo Harbour, Ladysmith, on Oyster Harbour, and Union, about 12 miles from Comox Harbour, besides being the cause for the building of extensive wharves, bunkers and coal washers at the harbours. Coke is only manufactured at Comox, where a plant of 200 bee-hive ovens has been constructed. The coke manufactured at that point, although carrying a somewhat higher percentage of ash than the best Pennsylvania coke or the Crow's Nest Pass coke, has always found a ready market in the coast smelters and previous to the development of the Crow's Nest Pass coal field was used by the smelters in the interior of British Columbia.

In the southern portion of this coal field there are two workable seams of coal designated as the Wellington and Douglas; of these the Douglas is the upper seam and is mined at the Nanaimo and Alexandria collieries, while the lower is only mined at the old Wellington and Extension collieries, in which fields apparently the upper seam has been carried off by erosion.

Much faulting has occurred through this portion of the island, which of course causes many complications in the workings. For instance, a bore-hole on the Harewood property, which adjoins the Nanaimo Colliery property, exposed a workable seam of coal, but a shaft sunk about 200 feet from the bore-hole failed to intersect the seam at the depth estimated and later investigations prove that a fault has occurred in the space between the shaft and bore-hole which was not apparent on the surface, and the downthrow had been 80 feet.

The total area of the productive territory of the coal fields on the east coast of Vancouver Island cannot be estimated because no accurate detailed geological survey has been made. With the exception of the Wellington Colliery proper, which was the private property of the late Honourable Robert Dunsmuir and at which work was suspended some months back, the acreage owned by the New Vancouver Coal Mining and Land Co. and a few small holdings, the entire field is included in the land grant of the Esquimalt and Nanaimo Railway Company. So far as the east coast of the island is concerned there are no other productive mineral-bearing properties, and in fact but comparatively little is known of the interior of the island to the north-west from the Mt. Sicker district, and south-easterly from Quatsino Sound, except around the head of the Alberni Canal, which body of water penetrates to within about 25 miles of the east coast with its entrance in Barclay Sound on the west coast. Quatsino Sound penetrates from the west coast to within about 10 miles of the east coast of the island and near the north-west end.

It was on the China and Granite Creeks which empty into Alberni Canal on the eastern side, where placer gold was discovered in the '80's, but the neighbourhood was not prospected for lode mines until since 1894.

Gold-bearing quartz bodies, occurring as long lenses with their lines of strike conformable to the trend of the country rock, have been mined on Mineral Hill, near the head of China Creek, and in the mountains near the head of Granite Creek, but at the present time no operations are being conducted. Some of this quartz carried extremely high gold values at and near the surface and was partially free milling, several tons of ore having been treated from the Consolidated Alberni group of claims on Mineral Hill and the 3 W's group near the head of Granite Creek. At the former of these properties the country rock is a schist but at the latter the ore occurs in granite. The schists of China Creek contain considerable hornblend and very probably are really altered granite. Further down the canal, which crosscuts the country, there is quite a marked change in the country rock and a wide zone of crystalline limestone, in which diorite, diabase and some felsite as intrusive dykes occur. In this have been discovered a large number of prospects carrying copper ores, usually chalcopyrite, associated with pyrrhotite, some of which have been productive, and on one at least some 5,000 feet of development work have been performed. This zone appatently extends to the north-west for quite a considerable distance, because the streams which empty into the inlets further to the north-west crosscut similar formation, in which a great many prospects carrying the same character of ore—but associated with magnetite, as a rule, instead of pyrrhotite – have been located. A prominent feature with regard to the ore bodies in this zone is the phenomenal appearance of

the outcroppings, both as to extent and grade, while another prominent feature is the complicated geology as demonstrated by the mine workings. Apparently this particular zone disappears under the ocean in the vicinity of Nootka Sound.

In the mountains near the shore line of Sydney Inlet occurs a mineral-bearing zone which, judging from the character of the country rock, belongs to or is an extension of the same zone as has just been described, but in which the character of the ores differ, to this extent that extensive bodies of high-grade bornite occur, with which is associated at the deeper levels chalcopyrite. Although a very considerable amount of development work has been performed upon, at least, two groups, the Anaconda and Black Prince, and it is reported that considerable ore has been accumulated, yet because of lack of tramways to connect the mine working from the shore no shipments have been made. Between Sydney Inlet and Quatsino Sound but comparatively little prospecting has been done. The country is very difficult to travel in ; the mountain ranges are higher than is usually the case from Sydney Inlet to the south-east, the growth of timber is very heavy and the sallal and other underbrush extremely dense.

The most northerly productive section of the island is along the shore line of the main Quatsino Sound and its arms, where copper ores occur in enormous outcroppings and from which shipments, carrying satisfactory values, have been made to the smelters. These occurrences of ore are found at or near the contacts of crystalline limestone with felsite or other igneous dykes. Although the country rock belongs to Dr. Dawson's Vancouver series, yet the particular zone in which the mineral occurs, in the opinion of the writer, does not bear any relationship to that crosscut by the Alberni Canal, but appears rather to belong to another zone which crosses from the eastern side of the island. However, this is merely offered as a suggestion, as neither the writer, nor to his knowledge, anyone else has exploited to ascertain the extent of the zone towards the south-east or east. During the present year considerable activity has been shown in the development of this section and shipments have been made to the Tacoma and Crofton smelters. At the present time an aerial tramway is being constructed to facilitate shipment from the mines to the coast.

The non-cupreous magnetite deposits which have been before referred to in this paper, as occupying a zone along the west coast of the island, have during the past two or three years received a great deal of attention from syndicates which acquired bonds on all the available workable deposits possible, and have been developing such with a view of shipping the ore to the Irondale furnace in the State of Washington for manufacture into pig-iron.

So far as the writer's observations have gone this zone is apparently entirely distinct, so far as the mineral deposits are concerned, from any other on the island ; but so far as the country rock is concerned, practically the same geological conditions exist as in the copper-bearing zone already described. The known deposits of magnetite occur on the Gordon River, which empties into the San Juan Harbour, about 70 miles west from Victoria ; Serita River, which empties into Barclay Sound, near the entrance to Alberni Canal ; Tzartoos or Copper Island, situated in Barclay Sound ; and on Sechart Peninsula, a promontory north-westerly from Copper Island, and also in Barclay Sound. Whether the same zone extends farther to the north-west has not, to the writer's knowledge, been yet determined, but deposits of iron ore are reported as occurring in the mountains near the shore line of Nootka Sound.

From the foregoing paper some idea can be gleaned as to the possibilities of the mineral resources of Vancouver Island when thoroughly exploited and developed. The writer has only attempted to go into the subject in a crude manner and not in the finished, comprehensive style which the subject really merits.

Notes on Machinery Constituting a Mining Plant.

By Alfred C. Garde, M.E. Sandon B C.

The following notes may be found useful to mine investors and engineers in charge of mining properties, and, although written with a particular view to conditions in British Columbia, pertain to mining elsewhere as well.

From the very time that a mineral claim passes out of the prospector's ownership the question "how to work the property at the least expense and with the best results" presents itself to the investor, and that this has been an important as well as a difficult question nobody will doubt when referring to the numerous idle plants of more or less value found in nearly all mining camps.

Any mining failures cannot but reflect on mining in general and should therefore be guarded with all possible care by the professional engineers.

To make a paying investment and a mine out of a prospect without employing other power than hand labour is hardly possible nor excusable now-a-days, except perhaps where the formation is unusually soft and the ores of very high grade, or possibly where the property is remote from any convenient point of transportation. In certain sections of the Slocan and Lardo districts conditions of this nature exist, but, being rather exceptional, do not exactly come in under the class of mines referred to here.

Hand labour should therefore only be employed to prove the property to a reasonable depth, perhaps one hundred feet or so, or sufficient to warrant the investment in a medium sized hoisting plant; but here I have frequently observed that instead of getting a medium sized hoist, say a 10 x 12, that would develop the property for a couple of years, a large plant, and sometimes even direct motion hoists with corresponding equipments are put in. Anyone that is interested and makes inquiries why a smaller plant would not have answered the purpose, receives invariably the same answer, viz.: Expectations of having a great mine some day, which would make it impossible to get along with anything smaller. If the mine turns out to be wonderful, good and well, but the chances for becoming a great mine are nearly always against the prospect. The number of claims recorded every year compared with the number of paying mines shows this only too well ; but even supposing that the small hoisting plant, within a couple of years, should have to be replaced with a larger one, there is hardly a stock-holder to be found in any country that would not be pleased to learn that the mine was producing ore so rapidly that the original prospecting plant was now unable to cope with the increased output. The above does not pretain to hoisting plants alone but to all matters pretaining to mining and milling investments as well, and it is hardly necessary to add that if this first principle of ecoromy in mining ventures had been followed out more generally during the past history of mining in British Columbia, considerable of the investors money and disappointment would have been saved.

Hoists.—In regard to hoisting machinery I find that it is quite common to see ordinary cast-iron gears and pinions used. As a matter of fact a hoist should not be permitted to handle men anywhere without having the most perfect kind of gearing. I would recommend to use a cast-steel gear with well cut teeth running together with a rawhide pinion. I have used this design successfully even on large double cylinder hoists, where the hoisting speed at times would exceed 1000 feet per minute, and where a speed of 600 feet per minute with the ordinary cast-iron gears would be considered unsafe and excessive. The rawhide pinion also does away with 50 per cent. of the objectionable noise peculiar to geared hoists, and reduces friction as well as wear of teeth.

Where two drums have to be used the main shaft should be in one piece and supported by three pillow-blocks. One substantial gear with rawhide pinion placed as close to the centre journal as possible will be found to give better satisfaction than two smaller gears on either side. Drums should be loose on the shaft and provided with removable composition metal bushings. Each drum should be operated by an independent friction clutch, keyed to the shaft close to the main gear, so that the drums can be run in balance or independent of each other as required. The engine should be fitted with reversible link motions of forced steel.

For a brake device I prefer the post brake to which a very neat safety contrivance for over-speed can be attached. It consists of a small speed governor geared from the main shaft. Whenever the speed exceeds the safety limit—say 1000 feet per minute—the automatic governor will cause a throttle valve to open, thus permitting steam, or preferably, compressed air, into two small air cylinders having their piston rods directly connected with the post brakes in such a manner that the compressed air forces the piston down, setting the brakes at the same time. One mutual governor will do for both sides but each post brake must have its own independent air cylinder.

To take care of the surplus hoisting rope and to save the dead coils from being worn by that portion of the rope which is in constant use a false reel can be placed inside of each drum and so arranged that the extra rope can be conveniently let out through a slotted hole in the rim of the drums whenever required. This avoids rope splicing.

Unless the mine is producing 500 tons per 24 hours from a depth of 1500 feet or more I prefer a self-contained double cylinder 14 x 18 geared hoist of the above description even to a first-motion hoist. The amount of material that a hoist of this character is able to handle is quite astonishing, especially where two skips, each of two tons capacity are used.

Skips versus *Cages*.—For vertical shafts where the vein is perpendicular or nearly so it is only fair to admit that the well known mining cage has done good work, but wherever it is possible to use a skip or skip-car I always prefer it to the cage. Within the last few years the skip system has gained much favour and has been introduced pretty well throughout all the large mines in Butte, Montana, as well as South Africa, both for vertical and incline shafts. It stands to reason that where a large amount of material has to be handled from several levels and from a considerable depth, a single-deck cage with room for 1 ton car only is quite insufficient, and two, three or even four deck cages will have to be employed to do the work, in such cases the combined dead weight of cages and cars becomes both enormous and impracticable. I remember two well know mines in Butte where four-deck cages were used until a five ton vertical skip was introduced. Each deck was carrying a one ton ore car, and the combined weight of four cages and four empty ore cars aggregated 9600 pounds, or 2400 pounds of steel per ton of material hoisted, while a five ton vertical skip that was put in later on only weighed 5000 pounds, being equal to 1000 pounds of steel to one ton of material hoisted. Where good fuel is expensive and several thousand tons of material are hoisted every day, as in the above case, the amount saved in coal represents a very handsome yearly dividend. The same rule also applies to a smaller hoisting plant. The average weight of a standard mining cage is about 1200 pounds and a 16 cu. ft. standard ore car weights about 800 pounds, making a total of 2000 pounds, while a one ton skip or a skip car with safety clutches, will not exceed 1500 pounds. If 200 trips are made during 24 hours the extra dead weight would amount to 50 tons or 25 per cent. of the hoisting capacity.

To make the skip system a success it is necessary to have bins or ore pockets cut out at each station in the mine so as to receive the ore or waste made during one shift. When the car-man has emptied his car into the ore pocket he returns to the chute to re-fill it. Any time during the shifts the pockets are emptied and it will then require a man at the bin gate to fill the skip and prevent spilling of material down into the shaft. This last feature was solved in vertical shaft propositions when the pneumatic ore-bin gate was introduced in Butte, as it enables the operator to shut off the ore stream within a second, or in other words when the skip is loaded. In addition to the pockets at each level a storage bin will be required at the top landing. Depending upon the arrangement several combinations for handling both ore and waste on top can be made, depending upon the ingenuity of the engineer in charge. It will readily be seen from the above that by the skip system economy in labour is possible and the proverbial "waiting for the cage" is done away with. The skip is equally as convenient for handling men and material down to the mine and is safer than a cage.

It is generally advisable to have a large bin capacity on top as it is often necessary to store different classes of ore. Ideal conditions are those where the ore can be loaded directly into railway cars. A crusher and screen placed above the bin will always be found convenient for breaking and sizeing the ores. Ore bins and gallows frame can usually be built together and I think that in British Columbia wooden gallows frames are preferable to expensive steel ones. The danger from fire is equal in both cases, as wood cannot be avoided for the construction of floors and the cost is at least twice as much again as the best wooden frame.

Head sheaves should always be large and lined with rubber or hemp to save the hoisting rope. Wrought iron spokes cast in with the hub and rim should be avoided as the spokes soon will get loose and commence rattling. Substantial shafts made of hammered steel and self-oiling journals are recommended.

For hoisting rope a flexible plough steel, six strands 19 wire rope is the best. For a skip of one ton capacity a $\frac{5}{8}$ in. rope is sufficient and for a two ton skip $\frac{7}{8}$ in. It is very common to find too heavy rope used, which, unless the sheaves are proportionally large, will ruin the rope within a short time. The most convenient incline in a shaft using skips is 70 degrees. Rollers should be provided at intervals in the shaftway, thus preventing the rope from dragging on the foot wall.

For inside work over winzes and for sinking purposes, I like a friction hoist. It is not exactly the type of hoist that should be placed over an important outside working shaft, but will be found extremly convenient for prospecting with a bucket or small skip. Care should be taken that the hoist is not overloaded, in which case the friction might slip.

Where compressed air is used for hoisting purposes it will nearly always pay to re-heat the air just before entering the cylinders. The re-heater should be placed as close to the hoist or air drills as possible, and all pipes wrapped with waterproof asbestos covering. It is not always convenient to use coal under ground. In some cases coke, if not too expensive, might be used.

British Columbia is extremely fortunate in possessing large areas of desirable steaming coal, a feature which, I think, is only surpassed by the abundant water power distributed over the greater portion of the province. No other section in North America can probably equal it in that respect.

Where coal is used for generating purposes I find that 80 or 90 pounds steam pressure is frequently the limit. I should however advise to have the boilers built to carry 125 or even 150 pounds pressure as it will be found a saving of fuel to do so.

MINING INSTITUTE.

Holds Highly Successful Series of Meetings in British Columbia. Many New Members Elected, and a Provinciai Branch Organized.

A local meeting of British Columbia mine managers and mining engineers was held under the auspices of the Canadian Mining Istitute, at Nelson, British Columbia, on Wednesday and Friday, 10th and 12th September, in the room of the Board of Trade. There was an excellent attendance, among other representative mining men being the following :—

J. H. Tonkin, General Manager, Crow's Nest Pass Coal Co., Fernie.
J H. MacKenzie, E.M., General Manager, LeRoi Mining Co., Rossland.
Bernard MacDonald, E.M., General Manager, Rossland Great Western, Rossland.
S. S. Sorensen, M.E., Velvet Mines, Ltd., Rossland
Wm. Thompson, Superintendent, Le Roi No. II, Rossland.
S. S. Fowler, S.B , E.M.. London and B.C. Gold Fields, Nelson.
Leslie Hill, C. and M.E., Hastings (B C.) Exploration Co., Nelson.
R. R. Hedley, Hall Mines, Ltd., Nelson.
James Cronin, St. Eugene Cons. M. Co., Moyie.
James McEvoy, Crow's Nest Pass Coal Co., Fernie.
Frank Fletcher, P.L S , Nelson.
James W. Moffatt, B.Sc., Nelson
Norman Carmichael, Assayer, Nelson.
Ernest Woakes, M.E., Duncan United Mines, Nelson.
A. C. Garde, E.M., Payne Consolidated, Sandon.
S. F. Parrish, E.M., B. C. Chartered Co., Eholt, B C
H. G. C. Croasdaile, Nelson, B.C.
Alex. Sharp, Mine Superintendent, Rossland.
H. Mortimer Lamb, Editor B. C. Mining Record, Victoria.
E. B. Kirby, E.M., General Manager, Centre Star Mining Co., Rossland.
Bruce White, Molly Gibson M. Co., Nelson.
M. H. Davys, C. & M.E., Nelson, B.C.
A. H. Gracey, Venus and Athabasca Mines, Nelson, B.C.
G. W. Chaplin, St. Catharines, Ont.
E. E. D. Wilson, Kingston, Ont.
Smith L. Curtis, M.L.A , Rossland, B.C.
H. C. Black, Nelson, B C.
B. T. A. Bell, Editor *Canadian Mining Review*, Ottawa.

The opening session was held on Wednesday afternoon, 10th September, at three o'clock.

On motion of the Secretary, Mr. S. S. Fowler, E.M., was called to the chair.

Mr. S. S. FOWLER, in welcoming the members of the Institute to Nelson, referred to the excellent work done by the organization on behalf of the profession and industry of mining in Canada. The proposition to organize a local branch in the Province was one which received his heartiest commendation, and would doubtless be carried out. The following new members were elected.

NEW MEMBERS.

Dr. Bernard Mohr, Mond Nickel Co., London, Eng.
Mr. Wm. Thompson, Superintendent, LeRoi No II, Rossland.
Mr. J. H. MacKenzie, E.M., LeRoi Mining Co., Rossland.
Mr. S. S. Sorensen, M.E., Velvet Mine, Ltd., Rossland.
Mr. J. H. Tonkin, General Manager, Crow's Nest Pass Coal Co., Fernie.
Mr. Thomas Stockett, Junr., Superintendent, Crow's Nest Pass Coal Co., Fernie.
Mr. James Cronin St. Eugene Con. Mining Co., Moyie.
Mr. George L. Griffith, C.E., Winnipeg.
Mr. Frank H. Probert, M.E., Los Angeles, Cal.
Mr. Edward H. Sanborn, Con. Lake Superior Co., Philadelphia.
Mr. A. R. Wilson, Crow's Nest Pass Coal Co., Fernie, B.C.
Mr R. W. Coulthard, Analytical Chemist, C N.P. Coal Co., Fernie, B C.
Mr. H. C. Riehle, Mining Engineer, Black Lake, Que.
Mr. H Mortimer Lamb, *B. C. Mining Record*, Victoria B.C.
Mr. James W. Moffat, B.Sc., Nelson, B.C.
Mr. Norman Carmichael, Assayer, Nelson, B.C.
Mr. Frank Fletcher, P.L.S., Nelson, B.C.
Mr. A. H. Gracey, Athabasca-Venus Mines, Nelson, B.C.
Mr. Aaron H. Kelly, Nelson, B.C.

MINE SIGNALLING BY COMPRESSED AIR.

Mr. WM. THOMPSON, Superintendent of LeRoi No. II, Mining Company, presented a paper on this subject, reproduced elsewhere iu this REVIEW.

TIMBERING BY THE SQUARE SETT SYSTEM AT ROSSLAND.

Mr. BERNARD MACDONALD, General Manager of the Rossland Great Western Mines, Ltd., presented a summary of his paper on this subject, which provoked an interesting discussion among the members.

B. C. BRANCH ORGANIZED.

The SECRETARY explained that in accordance with a resolution passed at the last annual meeting, it had been determined to organize branches of the Institute in different sections of the Dominion, and two had already been formed in Ontario and Quebec. The Institute had a large and representative membership in British Columbia, and if this was organized into a Provincial Branch, meetings could be held at different provincial points more frequently, and doubtless much good could be accomplished for the profession and industry of mining in British Columbia.

Mr. BERNARD MACDONALD (Rossland)—I am satisfied it will be a great advantage to have a Provincial Branch of the Institute in British Columbia to compare ideas on mining practice in the various districts of the Province, and also to promote better mining legislatiou.

Mr. E. B. KIRBY (Rossland) concurred, and suggested that, inasmuch as many of the members of the Institute were also members of the British Columbia Mine Owners' Association, it would be advantageous to both if it could be arranged to hold their meetings at the same time and place. One meeting could be devoted to business and government questions, and the other to the discussion of papers.

After some further discussion, a resolution—"That a branch of the Institute in British Columbia be now formed," was unanimously adopted. The appointment of a committee of management was deferred until a later session.

The meeting adjourned at 5.30 p.m.

WEDNESDAY EVENING SESSION.

The members reassembled at eight o'clock, Mr. Leslie Hill, C. & M.E., Nelson, being called to the chair.

COARSE CONCENTRATION IN THE SLOCAN DISTRICT.

Mr. S. S. FOWLER, S.B., E.M., presented his paper on Coarse Concentration in the Slocan District, B.C., reproduced elsewhere in this issue.

The paper was discussed by Messrs. Woakes, Harris, Hill, Garde, Cronin and others.

THE INFLUENCE OF GOVERNMENT UPON MINING.

Mr. E. B KIRBY (Rossland)—In most mining districts of the world the difficulties which we as engineers have to confront are mainly business-technical problems. Methods and economies in mining, transportation, milling and smelting, studied both from the scientific and business side, absorb our attention. In few cases do questions of State economics force themselves upon us, because mining is almost everywhere a favored industry treated by governments with fostering care, and considered worthy of every sacrifice and every encouragement by the State. It is rightly recognized as the mother of industries, focusing the attention of the entire world upon each newly-discovered mineral area. Upon this all the resources of civilization in men, money and skill are poured out. Around it agriculture, stock-raising and lumbering spring up, railroads appear without the aid of land grants or subsidies, manufactures and towns follow, and a commonwealth is established.

Now the British Columbia mining industry is unique in the world, not only in its entire lack of State recognition and fostering, but in the fact that difficulties imposed by State economics overshadow in importance all the ordinary technical and business problems with which mining men have to deal. It affords today a curious and interesting illustration of the injury wrought by unwise government, and also of the reaction of repressed mining on commerce and other industries. These effects are emphasized by contrast with the present prosperous condition of the other Provinces of the Dominion and also of the United States.

It is clearly recognized by the Canadian Mining Institute that British Columbia contains one of the largest and most promising mineral areas of the Dominion. But in considering the welfare of its leading industry of what use is it to concentrate attention on the fine points of machinery, mining methods and ore treatment if we ignore such realities as a Government tax-

ation which amounts to one-fourth of the gross value of its product? And a single item of which bars the treatment of low grade ores.

The phenomenon before us presents the following features: The Rocky Mountain range has been developed from lower South America to British Columbia, yielding a practically continuous chain of productive mining districts. It is found equally productive at the two points touched of Southern British Columbia and the Yukon. The unexplored area between, some six hundred miles of which is in British Columbia, should average up as well as that already known. Concerning the development of this area I quote from a memorial of the British Columbia Mining Association, of June 28, 1901:—

> "The development of these resources, begun a few years ago so "auspiciously, has been brought to a practical standstill, and whereas a "few years ago the mountains were swarming with prospectors, today "these pioneers of the mining industry have practically disappeared. "The flow of capital into the Province has been practically cut off, the "metal production is at present decreasing, numbers of producing "mines have closed down and those operating have with few exceptions "ceased to pay dividends. The working mines are struggling under "heavy burdens which are still accumulating each year. It is now "frankly admitted by mining men that the industry is prostrated in "many mining divisions, and that its condition is rapidly becoming "worse."

Allowing for all the reaction from the mining boom the Association correctly ascribes the increasing paralysis to two main causes—excessive taxation and oppressive legislation.

At present conditions are even worse than those described. Prospecting, and the development of new deposits to replace those exhausted, have practically ceased. Of 14,326 Crown-granted and recorded claims held December 31, 1901, only 78 yielded ore in excess of 100 tons total production for the year. This is about one claim in every 2,000 held. The bulk of the tonnage was confined to a dozen or so mines, most of these operating at a loss. The increased metal statistics for 1901, $15,000,000 against $11,348,000 for 1900, was due entirely to two mines, neither of which yielded dividends, and one of which has announced a large increase in its debt. Moreover, the statistical figures of production are fictitious in that the metals are valued theoretically by New York quotations for the refined product, the true or actual values received by British Columbia industry being much less. Meanwhile the serious financial condition of the Province has been clearly shown by Mr. F. J. Proctor in his pamphlet on "The Financial Crisis in British Columbia'" and it is currently reported that the Government met with failure in its recent attempt to float another loan in London. The stagnation of commerce and the present exodus of population is recognized by everyone.

It is not of interest here to go into details about the oppressive and threatening legislation which in British Columbia has so characterized the dealings of the State with its chief industry. What is of interest is the spectacle. unknown elsewhere in the Dominion or in the Empire, and probably unparalleled in the world, of a mining industry trying to exist under a burden of taxation which amounts to between 20 and 30 p.c. of its gross product.

The gross products of British Columbia in 1901, were about $27,000,000, distributed as follows:—

Industry.	Probable Annual Production.	Per Cent.
Metal mining	$15,070,382	55.1
Coal mining	5,016,398	18.3
Fisheries	3,065,900	11.2
Lumbering	1,690,000	6.2
Agriculture and Miscellaneous	2,520,000	9.2
	$27,362,680	100.7

Without considering an increase of about $800,000 yearly in the $10,000,000 debt, the actual taxes collected, Dominion and Provincial, amount to $5,350,000 which is 20 p.c. of everything produced. This is from a population which probably does not exceed 125,000 or 130,000 whites. Through the shifting of taxation by other industries onto mining the burden on the latter probably approaches 30 p.c. of its product, even when the latter is valued by the aforesaid fictitious method. In this remarkable state of affairs the fact that mining exists at all is the strongest evidence of the value of British Columbia's mineral deposits, and of the future which awaits the industry here when these artificial burdens are removed.

Even if the total load permitted it low grade ore must remain for the most part untouched on account of the so-called 2 p.c. tax on the gross output of mines. This tax is only one item in the total mentioned above but it has the peculiar effect of exacting an increasing proportion of the profits on the lower grade of ores. For instance, on the milling grades of Rossland it will seize anywhere from ten to twenty per cent. of the net profit. This bars Treadwell's in British Columbia.

The present state of affairs is instructive not only to the mining profession, showing how unwise Government can injure mining, but also to students of economics, presenting an extreme case of the blighting effects of taxation upon industry. To the student the phenomenon is marked by the same familiar symptoms which always accompany evils caused by acts of the political organism. There is the same curious indifference and refusal to see facts as they are, the same tendency to ascribe the evils to every cause but the right one. There is the usual effort to conceal the truth from the outside world and to condemn those who boldly and clearly call for reform. There is the same old anxiety not to correct the evil but to find excuses for evading action.

WHAT GOVERNMENT COULD DO FOR MINING.

Buckle, in his history of Civilizatiou, briefly characterizes its progress as the abolition of bad laws. Beyond this, industry requires nothing. All it wants from the State is what Diogenes asked from Alexander, "Keep out of my sunlight." As every economist knows the State is all powerful to injure industry but cannot directly aid it except by the familiar procedure of assisting one branch by robbing others for its benefit. Indirectly, however, the State can do wonders by the gradual, persistent removal of laws which oppress. Few people realize the sensitiveness of industry, or the narrow margin of profit by which it lives. Upon its delicate organization taxation acts literally like the hand of death. It shrinks, withers or dies at its touch. Taxation which is excessive or badly placed is worse in effect than war or pestilence. As industry declines the burden becomes heavier on the survivors, and thus the disease accelerates its own progress. Such taxation kills the goose that lays the golden eggs, and the bankruptcy of the State inevitably follows.

The simple principles of modern scientific taxation are well understood. In theory if not in practice the world has advanced since Colbert, the famous Minister of France, summarized government finance simply as "the art of plucking the goose with the least amount of squealing." In the light of modern knowledge taxes may be so laid that industry is not only uninjured, but is on the contrary actually benefitted by them. In this 20th century there is no excuse for excessive taxation or mediæval methods.

The State, if it will, may not only relieve the "mother of industries" from all its burdens, but may in a less important way encourage and aid it by attending to those matters which are beyond private enterprise. Maps, geological surveys, studies of districts, and the collection and distribution of all kinds of information valuable to the industry, are peculiarly the province of the State. It should, however, be confined to this field, the only exceptions being the few cases where it is necessary for the State to interfere by regulations for the distribution of mining property and for the public safety. It is easy for a Department of Mines to maintain such close touch and cordial relations with the whole industry as to secure its effective cooperation in all its work. It should in fact as well as in theory be its representative, its advocate and its watchful guardian.

As to the outlook for relief in British Columbia, we do not delude ourselves with any illusions. The disease has gone too far. History shows clearly that in all such cases the evil forces which control the machinery of government hold out against reform. No government ever reforms until it is forced to do so by the overwhelming power of popular will. The exertion of this power is always long delayed because of the apathy and blindness of the public towards economic questions and the long time required for it to recognize the causes of its distress. It is probable that a long period of depression and suffering will be necessary to educate voters and compel reform. Meanwhile only the richest and most fortunate enterprises will survive.

But notwithstanding the gloom of to-day we mining men, looking far beyond the present, have a clear view of the future grandeur of the commonwealth of British Columbia. We know its wonderful natural resources, the character and energy of its people. We know that civilization cannot be held back. Some day there will be good government, and with this one requisite supplied will appear an era of prosperity beyond the wildest hopes. Whether its arrival will find us here or laboring in other parts of the world we neither know or care. We only know our present duty, which is to

maintain a united front to the evils before us and to steadily press the fight for reform.

The SECRETARY—Mr. Kirby's remarks open a wide field for discussion. I am not, however, quite certain that the provincial tax upon your output is entirely responsible for the depressed state of mining in British Columbia. There has naturally been a reaction from the boom, and wild-cat speculation, incompetent management, over capitalization, depressed markets and other causes have played their part in bringing about this stagnation. A tax on industry is always to be deplored and while at sight this Goverument iupost may appear to be small it is unquestionably an onerous burden on an industry whose future success and prosperity must depend on the extraction of its low grade ores. Such a tax was proposed at one time in the Province of Quebec but was happily abandoned. In Ontario an export tax upon copper and nickel ores has beeu urged but we are in hope that this too will never go into operatiou. I am sure we are all indebted to Mr. Kirby for having so ably given us such a vital topic for discussion at this meeting.

Mr. BERNARD MacDONALD having referred to method of raising revenue from the gold mining industry of Alaska emphasized the point that British Columbia mines paid Americau wages and their men worked shorter hours than they did across the line. They paid a heavy duty upon their machiuery and supplies and were burdened with a tax which virtually made the successful extraction of their low grade ores impossible.

Mr. WM. THOMPSON—I think we are specially indebted to Mr. Kirby for having spent a good day's work at the last moment in the production of this paper and I am sure his trenchant criticism of the treatment our industry receives from the Government cannot fail to be of the greatest possible benefit to the mining industry of British Columbia. We recently had the pleasure of entertaining the Hon. Mr. Prior, the Minister of Mines. We took him under our wing and did not do "a thing to him." (Laughter.) But as soon as he left our genial compauy and the Scotch begau to work off (laughter) he changed his tune and he now appears to be not quite so sure that the mining industry was dead. We should have regaled him with a red herring (laughter) for he evidently has goue from us with the idea that we really had some money after all and that the Government should have some more of it. (Laughter.) It is all very well for the Slocau mine managers to get together and for us in Rossland and in Nelson to sympathise with them but unless the public is made acquainted with the real facts, unless the people are made to realize the part which foolish legislation has played in bringing about this deplorable state of affairs, unless we act vigorously and in no uncertain manner on behalf of our own interests and the interests of our shareholders, I am afraid very little good will come out of it. As Mr. MacDonald and Mr. Kirby have well pointed out, the mining iudustries of the Province are severely handicapped by taxation and duties and there is an immense tonnage of ore on the dumps and in the mines which under better treatment and more liberal legislation would be mined at a profit and which must lie there untouched until conditions change. (Applause.) This state of affairs cannot go on. Hardly a session of the Legislature passes without some tinkering with our mining legislation—some new effort to hamper and restrict mining. Last session we had several examples. Just as soon as the Government is satisfied we are making progress, down comes the axe, and tomorrow the hours of labour may be still further reduced and the mineral tax increased. We asked Mr. Prior to give us a fair fighting chance. Our members at Victoria ought to know and be made to realize the injury foolish mining legislation has inflicted upon the mining industry of the Province, and an effort must also be made at Ottawa to secure relief from burdensome duties, especially upon our machinery and mining supplies. If this thing continues nothing else will remain but to shut down every mine and let them have them to themselves. (Applause.)

Mr. S. S. FOWLER—My company has spent a very large quantity of money in this Province during the past five or six years and has got very little of it back. Our working costs have been cut down and economies exercised in every direction but what use of it if this state of affairs is to continue. The whole subject resolves itself into this: Let this thing go on until those who are responsible for the present state of affairs starve to death or we get out of the country."

Mr. A. SHARP—Allow me to say how I appreciate the observations of Mr. Kirby and how much they have been needed not only at a meeting of the Institute but throughout the Province of British Columbia. I have lived in this Province for a great many years. I have tried in my own little way to affect the legislation of the Province just upon the lines upon which Mr. Kirby has laid before us tonight. There is no doubt whatever that the mining industry, as an industry, has been crippled in the way he pointed out to us At the same time, I cannot help saying that the mining engineers, the mine superintendents and the owners of the mines have hitherto been very much to blame. They have held aloof and been indifferent when they should have been active. I have appeared on the political platform at several elections and endeavored in my own little way to show the harmful effects of much of our provincial legislation. I have done so alone without a single associate. I would like to say, what I believe, that if mine owners, mining engineers and mine superintendents would use their great influence to counteract what is known as the popular cry in the Province we would be able to send members to the Legislature whose views would be more in accordance with our demands. I hope the Institute will go into this and aid us to prevent further legislation being enacted which will handicap mining as it is and has been in the past.

The SECRETARY—With respect to the suggestion to appeal to the Federal Government for a reduction or repeal of the duties on machinery and supplies, I would only say that in my experience of mining in Canada, extending over a period of some seventeen years, the present Government—and I speak with no political bias whatever, being neither Grit nor Tory—is the only Government during that period which appears to have appreciated the great value and importance of our mining industries and I am confident that any representations made to Mr. Fielding or to Mr. Sifton will receive their earnest consideration. It may be of interest to state that the Minister of the Interior has gone so far as to establish the neucleus of what promises very soon to evolve into a thoroughly well equipped Department of Mines. This is a step in the right direction. It is unfortunate that Dr. Haanel, the Superintendent of Mines, is not present to hear this discussion for he could have assisted us materially by presenting the views of this representative meeting to Mr. Sifton. Mr. Fielding for many years has taken a deep interest in the mining industry and I am sure he may be relied upon to do whatever is possible to give relief either by a reduction of some of the duties or, as he has done, by aiding certain branches of the industry with a bonus.

On motion of Mr. Thompson, seconded by Mr. Sharp, Messrs. Fowler, Tomkin, MacDonald, Kirby, Bell and Hedley, together with the mover and seconder of the motion, were appointed a committee to draw up a suitable despatch for the Associated Press and to transmit copies of Mr. Kirby's remarks to the papers of the Province.

The meeting then adjourned until three o'clock on Friday.

FRIDAY AFTERNOON.

The members assembled at three o'clock, Mr. Robert R Hedley in the chair.

BRANCH EXECUTIVE APPOINTED.

On motion, the following executive of the British Columbia branch of the Institute was elected:—S. S. Fowler (chairman) and R. R. Hedley, Nelson; E. B. Kirby and Bernard MacDouald, Rossland; F. Keffer and S. F. Parrish, Boundary District; James Cronin and A. C. Garde, Slocan; J. H. Tonkin, Fernie; W. F. Brewer and W. F. Robertson, Victoria.

FURTHER DISCUSSION OF MR. KIRBY'S PAPER.

The CHAIRMAN—It was thought desirable the other evening to have some further discussion upon Mr. Kirby's remarks on the influence of Government upon mining. We should be pleased to hear from any other members.

Mr. H. E. C. CROASDAILE—Mr. Kirby has given a great deal of thought to this matter as his paper shows, but the strong indictment of the Government which he presents requires to be substantiated before it goes abroad as the views of the members of this Institute. Statements such as those which he has made must have a serious effect upon the investment of capital in the Province. If it is shown that the present burden upon our mining industry amouuts, as he has stated, to 20 per cent. upon our output it is going to make men hesitate before they put their capital into mining in this Province.

Mr. E. B. KIRBY—I should only be too glad to give every explanation of the way in which I arrive at these figures. As you can readily imagine I would not have dared—no one would have dared—to present such appalling figures and stand responsible for them unless they were absolutely facts which I have verified from the most authentic sources. (Mr. Kirby proceeded to give figures in detail, but as these are subject to correctiou of our steuographer's report, it would not be fair to publish them until they have been revised by Mr. Kirby himself.) In the memorial of the Mine Owners' Association similar figures were given to those which I have just quoted. These have not been questioned. They have stood fire for a year and no one has ventured to call them to question. Every statement I have made I

am prepared to verify. I have some of the data with me over in my rooms at the hotel and back in Rossland. If Mr. Croasdaile or any other member would like to see them and to thoroughly go into details I would be only too glad to go into the matter with them.

Mr. H. E. C. CROASDAILE—I am afraid Mr. Kirby has ignored my question. What I ask him to explain is his statement that because the Province pays $5,400,000 in taxation therefore the mines are contributing 20 per cent. of their output. How does Mr. Kirby arrive at the conclusion that the mining industries are paying over four millions of dollars in taxation?

Mr. E. B. KIRBY—I did not know I was not answering the question fully because I desire to do so. Now the official figures of the mineral production of the Province show a total production of twenty-seven millions of dollars. Take the total taxation as shown by the blue books at $5,400,000. If you divide that you will find one is 20 per cent. of the other—where does this money come from? Does it come from the money borrowed by Tom, Dick or Harry? Does it come from the remittance men? It comes out of our production. You have $5,400,000 taken from us for the privilege of being governed and out of the balance we must pay expenses and dividends. (Mr. Kirby again goes into details which it were better to omit here until the stenographer's notes have been revised.) I don't know that there is any more that I can explain except to state in the most emphatic manner that there is no guess work about these figures. Those of us who pay out the cheques have a realizing sense of the truth of these statements. For instance, the "War Eagle" and "Centre Star" mines which have been operated something like seven and nine years respectively, have paid in dividends $640,000 and during the same period $160,000 in taxes, or about one-fourth.

Mr. BERNARD MacDONALD—I look upon Mr. Kirby's remarks as a simple statement of fact. If it would be acceptable to the members of the Institute it might be well to incorporate with Mr. Kirby's paper the statements presented in the Memorial of the Mine Owners' Association. The Memorial gives many figures which would substantiate the argument presented by Mr. Kirby.

The SECRETARY—If I remember correctly there were certain features of the Memorial which were not free from the suspicion of inaccuracy.

Mr. JAMES McEVOY—I do not quite understand from Mr. Kirby how he apportions this taxation. Would it not be fairer to state it as revenue derived directly and indirectly from mining?

Mr. KIRBY—It includes all possible taxes. We may apportionate it among the leading industries. You can figure it any way you please. We look at it from the standpoint of the mineral producer. Take, for instance, the mining districts of Rossland or of the Boundary, the taxes are derived it is true from different sources. But I repeat, where does this money come from? Suppose the mines were closed tomorrow how much revenue would be derived from Rossland?

Mr. McEVOY—I cannot see why the money paid, for instance, by a Nelson storekeeper should be credited to mining. That is hardly a fair argument. Upon the same principle one might take the whole taxes contributed by the other industries and place the amount to the credit of mining. I don't think these taxes are chargeable to mining in any direct way.

Mr. H. E. C. CROASDAILE—You must bear in mind that every citizen has to bear his share of taxation and it is absurb to claim that the revenue yielded by a mining community is a direct tax upon the mines.

Mr. WM. THOMPSON—I must confess that I am surprised that Mr. Croasdaile should stand up and assert that the mineral tax is the only direct tax upon our mines. Mr. Kirby desired to purchase a large hoisting engine. It could not be obtained in Canada. He purchased it in the United States and had to pay a duty of something like $6,000 on that single engine. What was that but a direct tax upon the mining industry? If a piece of machinery which costs $14,000 at Northport is laid down at Rossland for $20,000 surely that is a very serious disadvantage to the mining industry of British Columbia. We are taxed on our powder, on our candles, on our steel, our oil, in fact on everything we use in our mines. These mountains are rich in mineral wealth, but much of the ores are low grade and unprofitable to work under existing conditions. No mine manager objects to reasonable taxation. It is the accumulation of a little here and a little there until it makes it impossible to carry on mining and make it pay. No wonder that last year several millions were invested in Mexico from various sources but largely from London. Their mines are no better than ours but the investor is treated more liberally and it is possible to make something for the shareholders. I must certainly object to Mr. Croasdaile's contention that the two per cent. tax is the only burden our mines have to bear.

Mr. SMITH CURTIS, M.L.A.—I merely came to this meeting to listen and to learn, but I must say a few words. Whether we agree with Mr. Kirby or not, we should be thankful to him for having brought this important question of the taxation of our mines so clearly and forcibly to the attention of the members of this Institute. Mr. Kirby's statement of the revenue collected from the various industries is correct. I had occasion to verify these figures and I know they are substantially correct. We have heard of the heavy burdens placed upon the various industries of British Columbia, and of these the mining industries of the Province, coal and metalliferous mining, overshadow all others, and we have the right to ask whether these taxes are unnecessarily burdensome. It is our right to know how that revenue is applied, and how much of it is applied for the benefit and to promote the development of mining in the Province, but we have no time to discuss that to-day. Now, as to who pays the taxes, Mr. Kirby is quite within the mark. If you trace the source from which each person gets the money to pay these taxes, it will average at least 20 per cent., and a far greater proportion comes out of the mining industry. In the city of Rosslaud the merchants pay $3.00 poll tax; he has to get that money: where does he get it? He gets it out of the miner, and the miner gets it out of the industry.

The SECRETARY—I would suggest that Mr. Kirby's paper, together with the remarks of the various speakers, be published in pamphlet form after due editing and revision.

The CHAIRMAN—I think it is advisable to do so.

Mr. WM. THOMPSON then moved that Mr. Kirby's paper and the discussion, after revision by the members, be published in pamphlet form, as suggested by Mr. Bell, and that copies be sent to the ministers and members of the Legislature.

Mr. S. S. FOWLER seconded, and the motion on being put to the meeting was carried unanimously.

PAPERS READ BY TITLE.

The following papers were then read by title:—

On the Future of the Coal and Coke Supply of British Columbia.
By Mr. Wm. Blakemore.

On the Mineral Resources of Vancouver Island.
By Mr. W. M. Brewer, Vancouver.

On the Machinery Constituting a Mining Plant.
By Mr. A. C. Garde, Sandon.

EXHIBIT OF A MODEL OF THE POORMAN MINE.

The SECRETARY remarked that as Mr. Norman Carmichael, who had constructed the exceedingly interesting glass model of the Poorman Mine which had been on exhibition in the hall during the meeting, was present, the members would be pleased if he would make a few remarks upon the model.

Mr. NORMAN CARMICHAEL—I appreciate very much the kind remarks that have been made regarding the model on exhibition and the interest taken in it by the members present. I must explain, however, that the model was not made with a view to public exhibition and in many respects it is crude and unfinished. On it you will notice Eagle Creek flowing down the gorge, the profile of the hillsides, the outcrop of the vein, tunnels, stopes, dykes, faults and nearly everything connected with the mine but the 2 per cent. tax. My attention was first drawn to the striking manner in which the workings of a mine can be shown on glass by the beautiful models in the museum of the Bureau of Mines in San Francisco, which are well worth a visit; and later I was indebted to Mr. W. A. Carlyle, who was a strong believer in their usefulness, for some suggestions regarding plotting on glass, and also to Dr. James Douglas, of Bisbee, Arizona, who very kindly supplied me with notes on the construction of the large glass model of the Copper Queen Mine at that place. That mine models are of more than mere artistic value is shown by the extensive use made of them by the courts in Colorado and elsewhere to aid in the adjustment of many important mining disputes, and I have no doubt that were they more generally employed by mining engineers they would often prove an invaluable aid in the solving of difficult underground problems. In the present instance the model was constructed with a view to showing a rather intricate system of dykes and faults which traverse the vein in an irregular manner, the dykes varying in thickness from a fraction of an inch up to about 20 feet and for the most part dipping in an opposite direction to the vein, while the faults have in most cases caused a displacement of only a foot or two, one of them throws the vein some 25 feet and thereby affected the workings considerably in the grouud contiguous to it. These dykes and faults are shown in different

colors so that they may be more clearly traced in their meanderings through the mine. The model is made to a scale of 40 feet to the inch, the block of ground represented being 1,200 feet long by 800 feet wide, and with a vertical depth of 560 feet. The strike of the vein is made approximately parallel to the longest dimension of the model, and each sheet of glass represents a tranverse section through the vein and workings. The sections being placed at a uniform distance apart, corresponding to 50 feet in the mine, where important workings, such as upraises, fall between the regular sections and in consequence would not be shown on them, intermediate sections are set up at their correct angles. All the sections are easily removed and replaced, so that the model may be kept up to date with the surveys in the mine. If there is any further explanation desired by any one I shall be very pleased to give it.

Mr. ERNEST R. WOAKES, managing engineer of the Duncan United Mines, desired to bear testimony to the care that had been taken in making the model as accurate as possible, and to the practical utility of the model in the actual working of the mine, and felt sure that were the practice of making these models more general much benefit would accrue.

NEXT MEETING OF THE BRANCH.

On motion it was decided to hold the next meeting of the Branch in Victoria some time in March, 1903.

The meeting adjourned at 5.30 p.m.

ENTERTAINED BY THE CORPORATION.

On Thursday evening the members of the Institute were the guests of the mayor and corporation of Nelson at a banquet in the Hume House. About one hundred persons sat down to an excellent dinner. After the usual loyal and patriotic toasts, the mayor proposed the "Mineral Industries" in an excellent little speech. On behalf of the industry suitable responses were made by Mr. S. S. Fowler, Mr. B. T. A. Bell, and Mr. Bernard MacDonald. A splendid musical programme was presented and the festive gathering did not separate until daybreak was well advanced.

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The Northern Light Mines Company.—Incorporated 14th August, 1902. Authorized capital, $50,000.

The Algoma Consolidated Silver Mines Company, Limited.—Incorporated 12th August, 1902. Authorized capital, $1,000,000, divided into 1,000,000 shares of $1.00 each. Head office: Toronto, Ont.

BRITISH COLUMBIA.

The Kingston Gold and Copper Mining Company, Limited.—Incorporated 29th July, 1902. Authorized capital, $1,000,000, divided into 1,000,000 shares of $1.00 each.

The Myee Exploration Company, Limited.—Incorporated 11th August, 1902. Authorized capital, $150,000, divided into 150,000 shares of $1.00 each.

The Canadian Oil and Mines, Limited.—Incorporated 15th September, 1902. Authorized capital, $2,500,000, divided into 2,500,000 shares of $1.00 each.

The East Kootenay Placer Mining Company, Limited.—Incorporated 15th September, 1902. Authorized capital, $50,000, divided into 50,000 shares of $1.00 each.

The Revelstoke and McCullough Creek Hydraulic Company, Ltd.—Incorporated 11th September, 1902. Authorized capital, $125 000, divided into 125,000 shares of $1.00 each.

COMPANY NOTES.

Le Roi Mining Co.—The report for July from this mine is as follows:—"The tonnage shipped during the month, together with its contents and gross values per ton was as follows:—

	Dry tons.	Ozs Au.	Ozs. Ag.	Lbs. Cu. wet.	Value per ton.
1st class.....	14,492.734	8 437.974	14,099.69	672,314	$17.67
2nd class dump.....	1,677.534	1,005.887	1,376.89	55,332	$16.35
	16,170.268	9 443.861	15,476.58	727,646	—

MINE EXPENDITURE.

The expenditure for the month on mine account was..... $51,385.53

The cost of breaking and delivering ore on the railroad cars for the month was $2 87 per ton. The cost of loading second class ore from the dump was 27.3c., which, added to the 2 per cent. ore tax for the month, brings it to 40c. per ton. The cost of delivering first class ore on the railroad cars, including all mine expenditure other than cost of second class ore, was $3.50 per ton.

NORTHPORT SMELTER.

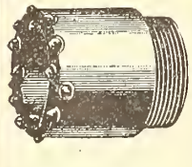
The expenditure for the month was..... ..... $5 ,314.86

The following statement gives the details of the ores received at the smelter during the month and the contents:—

	Dry tons.	Ozs. Au.	Ozs. Ag.	Lbs. Cu. wet.
Public Ores:				
Le Roi No. 2.....	6,454.924	3,255.196	7,700.19	293,483
Le Roi Ores:				
1st class.	14,492.734	8,437.974	14,099.69	672,314
2nd class dump.....	1,677.534	1,005.887	1,376.89	55,332
	22,625.192	12,699.057	23,176.77	1,021,129

The tonnage treated during the month was 19,965, segregated as follows:

Roasted ores.....	10,764.5
Raw Le Roi No. 2.....	5,006
Raw Le Roi second class	2,286.5
Raw Le Roi first class	1,908
	19,965.0

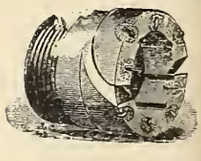


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WM. R. WHITE,
Liquidator of The Crystal Gold Mining Co.
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Dated PEMBROKE, June 26th, 1902.

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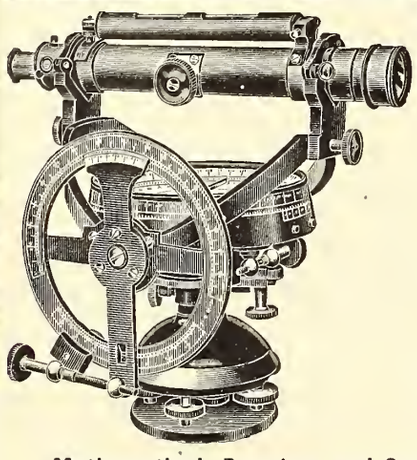
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   (*a*) Mining Engineering.
   (*b*) Chemistry and Mineralogy.
   (*c*) Mineralogy and Geology.
   (*d*) Chemical Engineering.
   GROUP II.
   (*e*) Civil Engineering.
   (*f*) Mechanical Engineering.
   (*g*) Electrical Engineering.
   GROUP III.
   (*h*) Biology and Public Health.
3. COURSES IN CHEMISTRY, MINERALOGY AND GEOLOGY for degrees of Bachelor of Arts (B.A.) and Master of Arts (M.A.

For further information see the Calendar of Queen's University.

4. POST-GRADUATE COURSE FOR THE DEGREE OF Doctor of Science (D.Sc.)

For further information see the Calendar of Queen's University.

Next Session begins October 1st, 1902.

MATRICULATION EXAMINATIONS HELD AT QUEEN'S UNIVERSITY, SEPTEMBER 16TH.

THE SCHOOL is provided with well equipped laboratories for the study of Chemical Analysis, Assaying, Blowpiping, Mineralogy, Petrography and Drawing. It has also a well equipped Mechanical Laboratory. The Engineering Building will be ready for occupation next session and the Geology and Physics Building the following session. The Mining Laboratory has been remodelled at a cost of some $12,000 and the operations of crushing, amalgamating, concentrating, chlorinating, cyaniding, etc., can be studied on a large scale.

For Calendar of the School and further information, apply to

The Secretary, School of Mining, Kingston, Ont.

Did You Hear the Thunder?

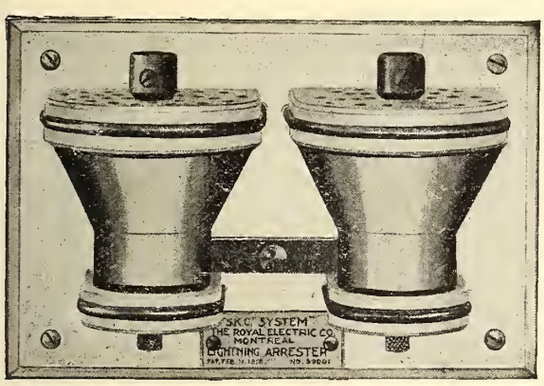
Where there is thunder there is lightning. Every electric plant should be provided with Lightning Arresters which will **PROTECT!**

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GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents anuually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc, are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

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The attention of Miners and Capitalists in the United States and in Europe is invited to the

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ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes:—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals*; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms:—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds: Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less, but not for more; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in-Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental - such royalties, unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at th mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order-in-Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end of the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 per acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee, $5.00, renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings, but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed or bars in the rivers below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River, and Hill claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim must hold a Free Miner's certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of 2½ per cent. on the value of the gold shipped from the Territory to be paid to the Comptroller.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek, or gulch, but the same miner may hold any number of claims by purchase, and Free Miners may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch, or river, by giving notice, and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00, and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette*.

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, at the rate of 2½ per cent. on the value of the gold shipped from the Territory. Operations must be commenced within one year from the date of the lease, and not less than $5,000.00 must be expended annually. The lease excludes all base metals, quartz, and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery, at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite: copper in sulphide and native form; gold, mostly in free milling quartz; silver, native and sulphides; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc, apply to

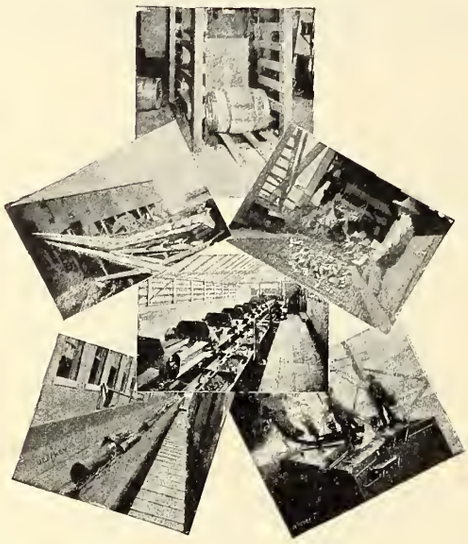
HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

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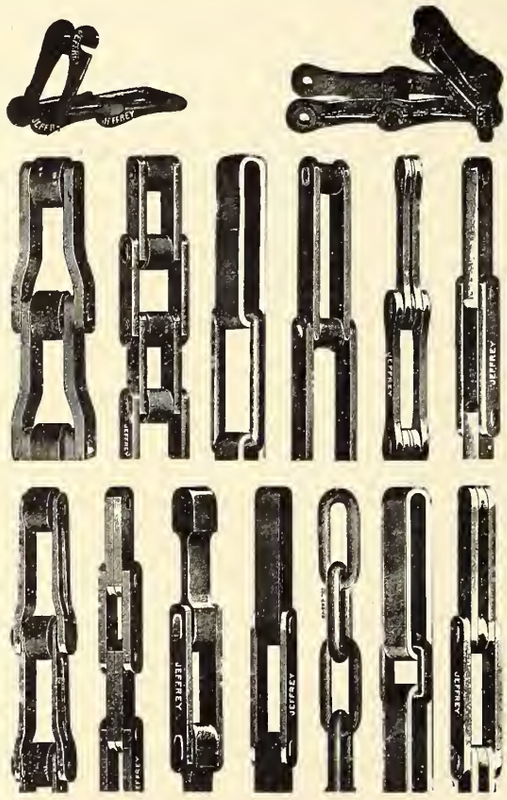


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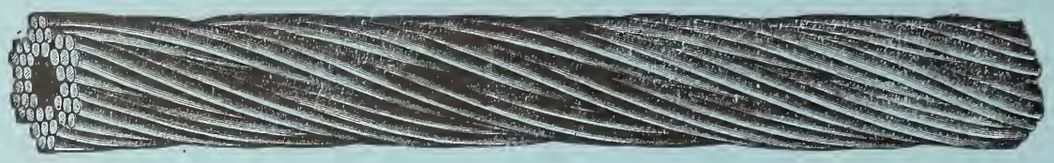
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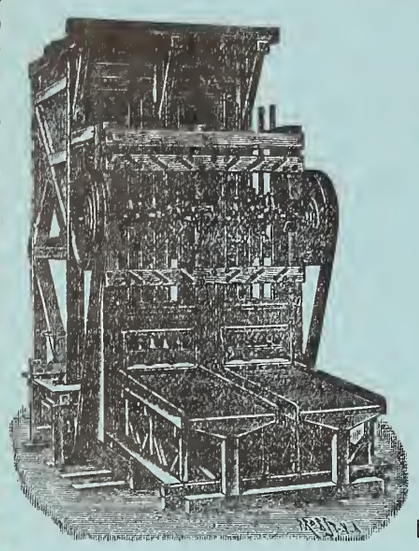
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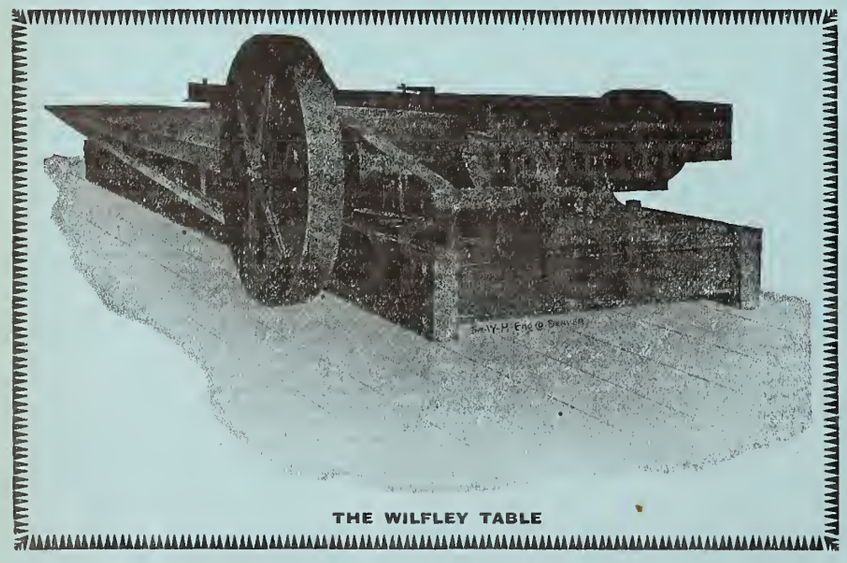
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THE WILFLEY TABLE

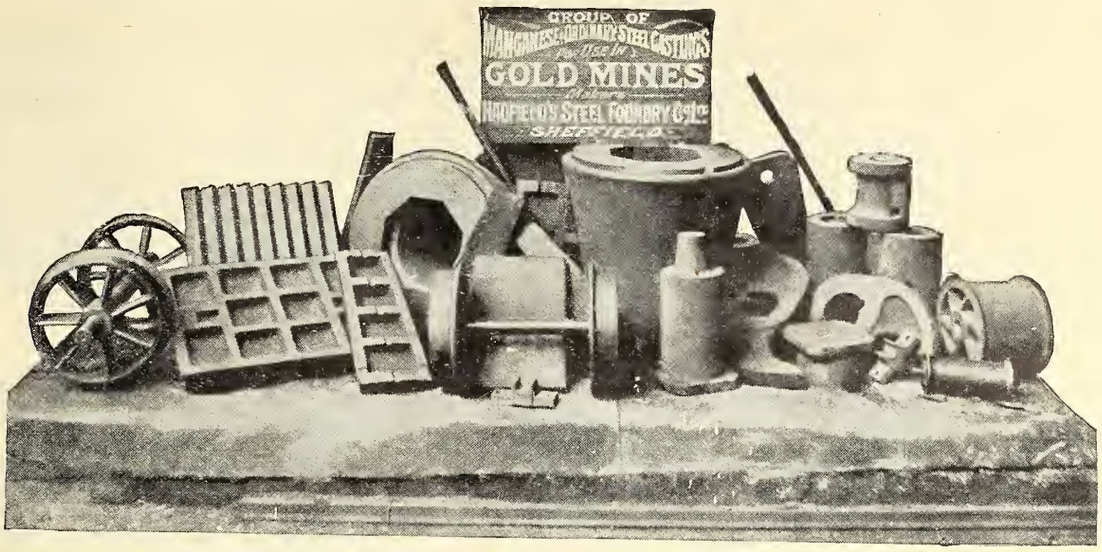
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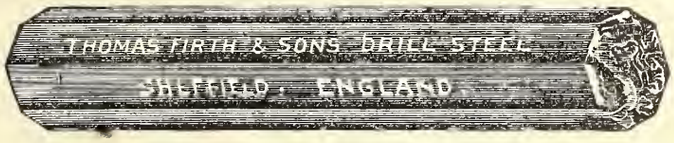
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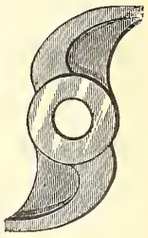




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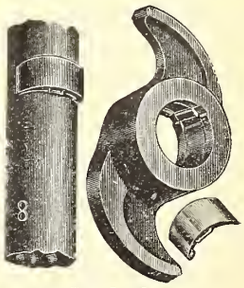


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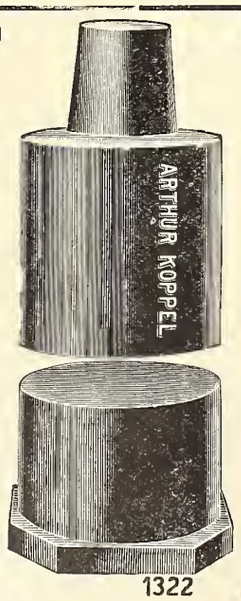
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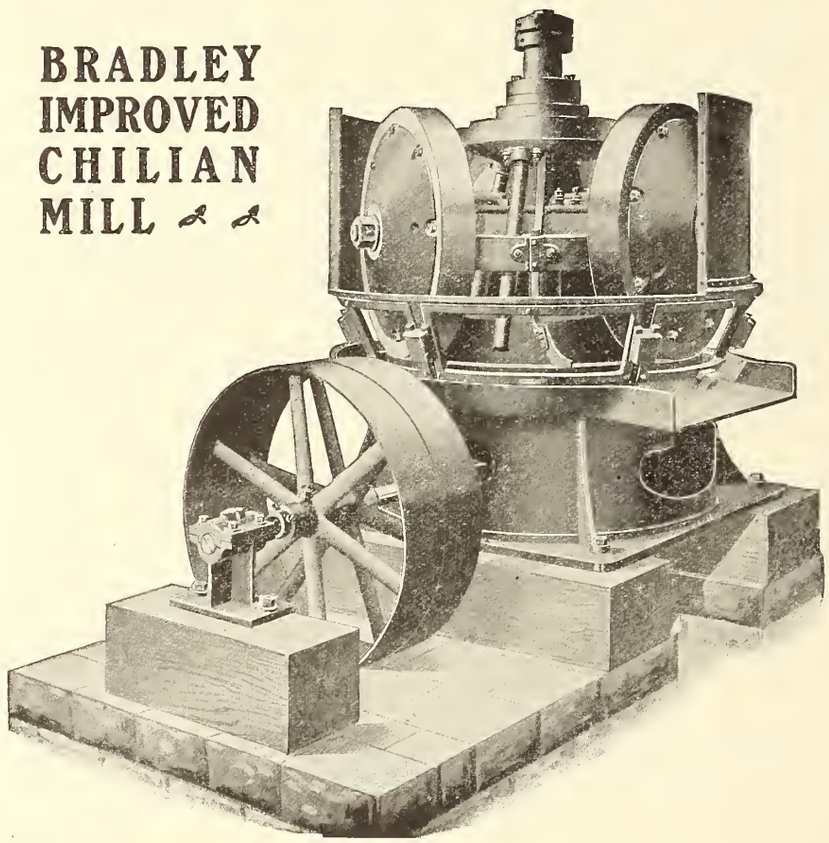
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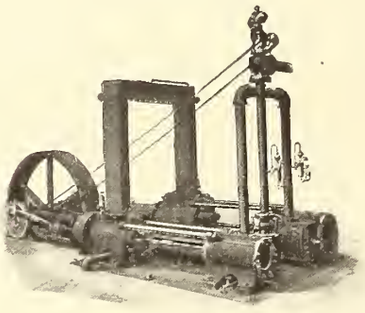
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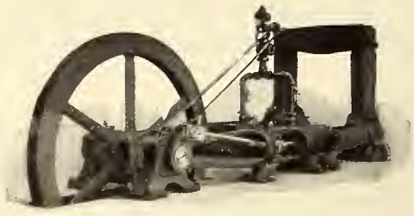
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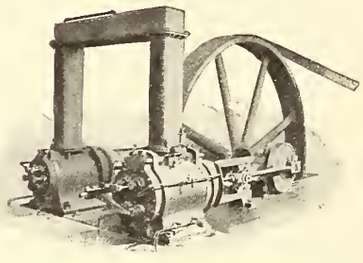
Class B-D Compressor
[Air Cylinders next to Frame]



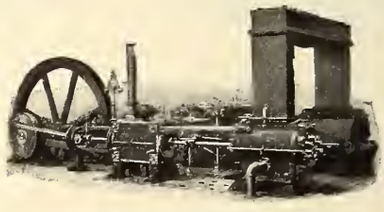
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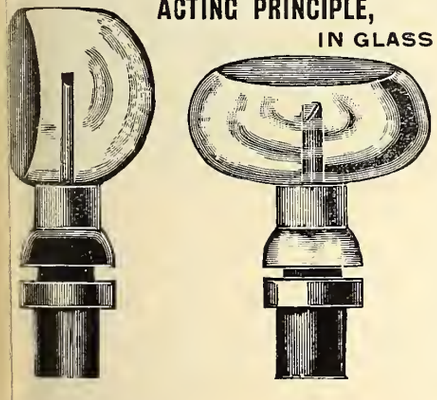
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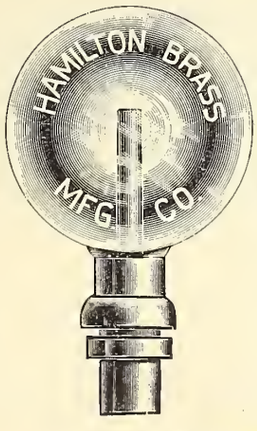
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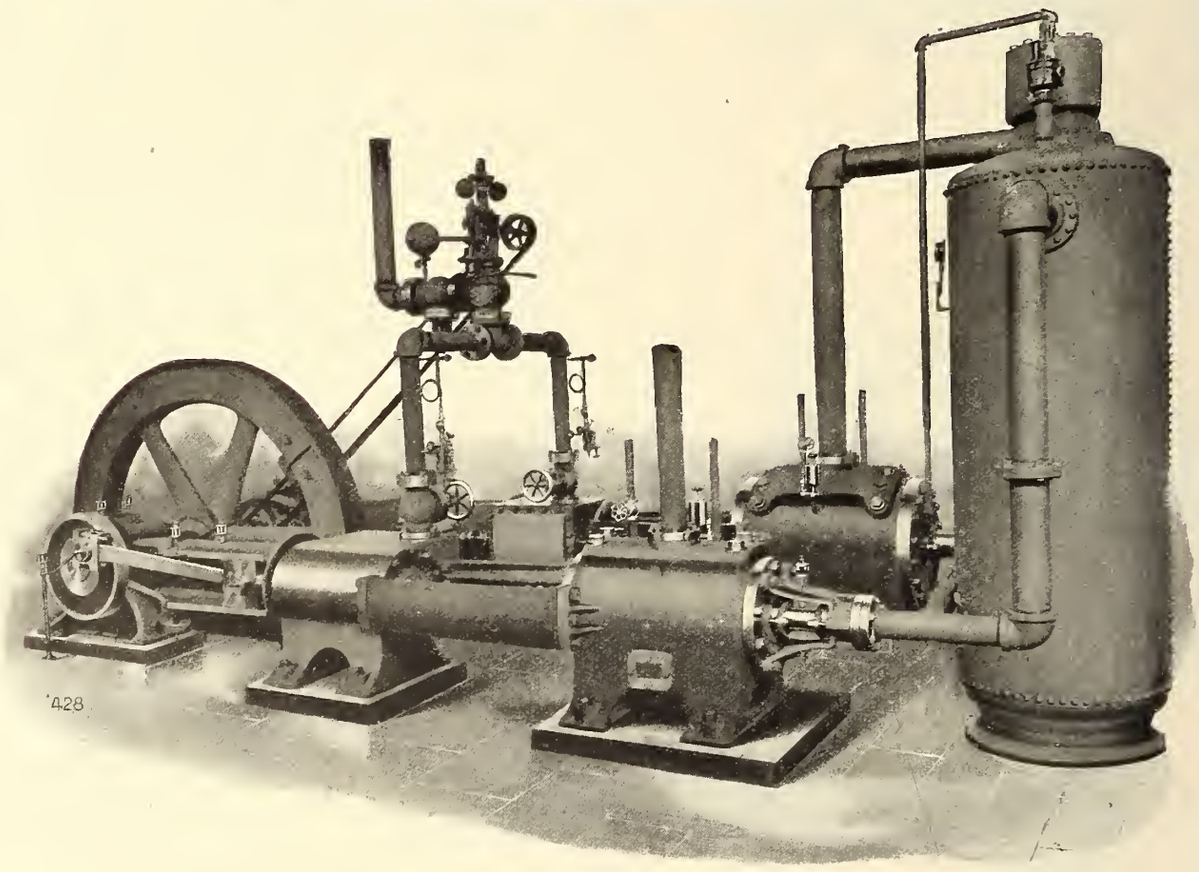
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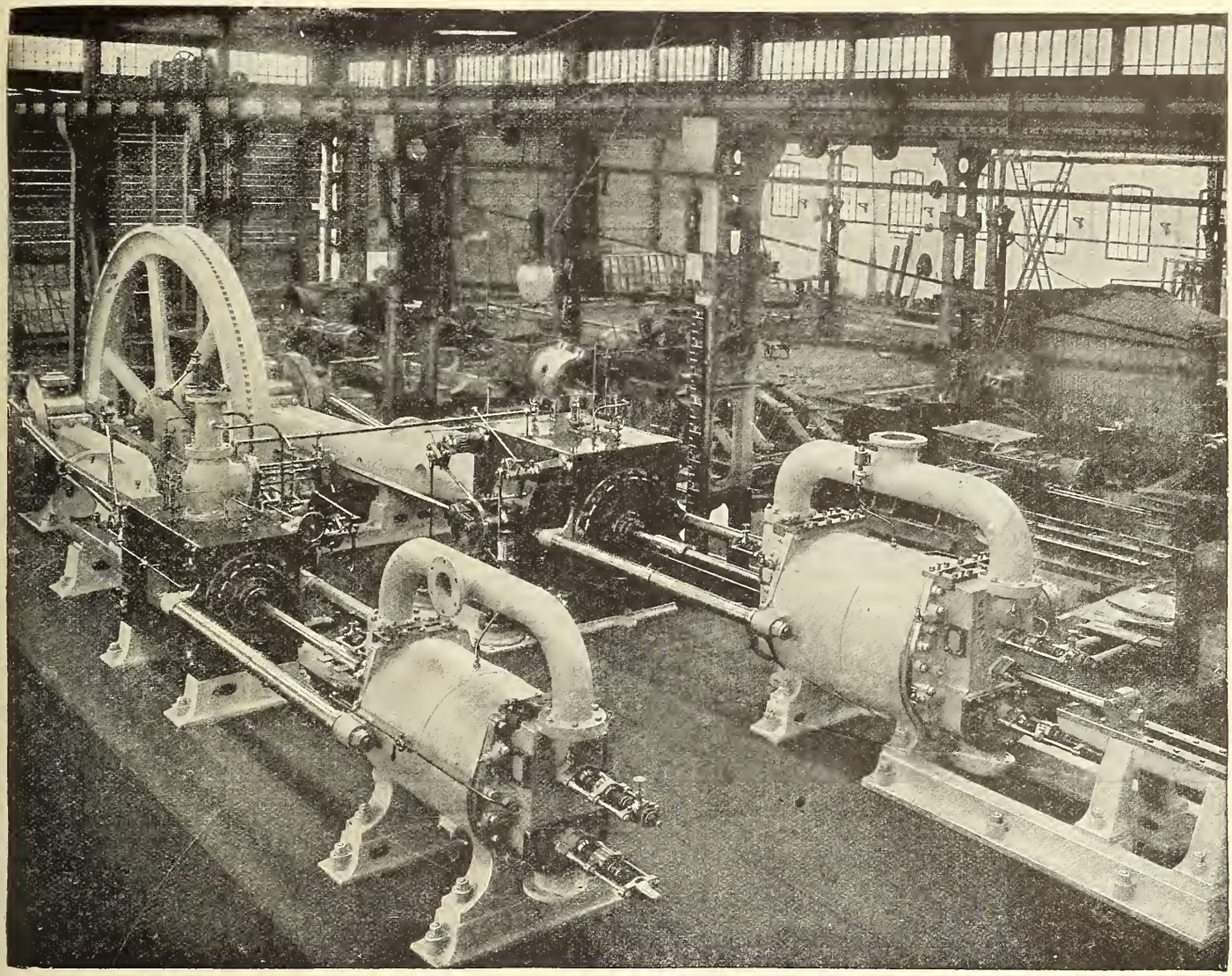
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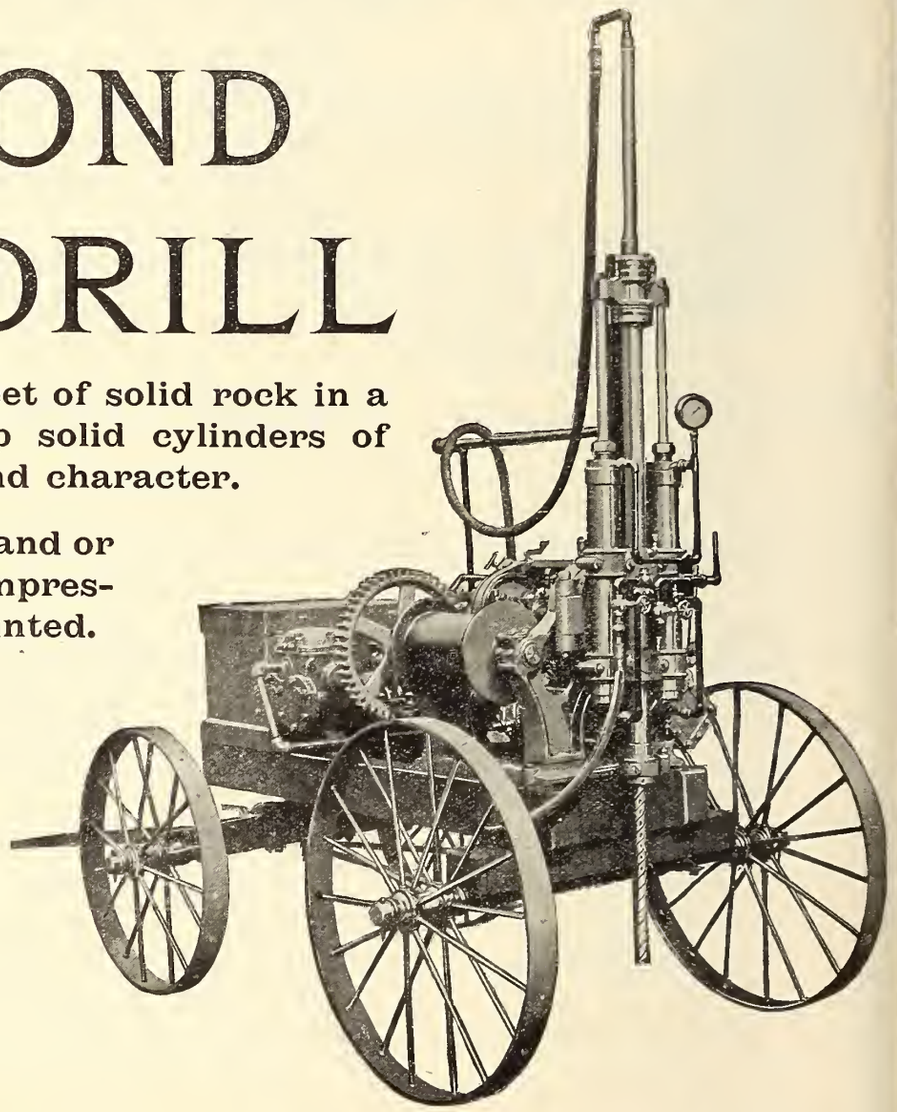
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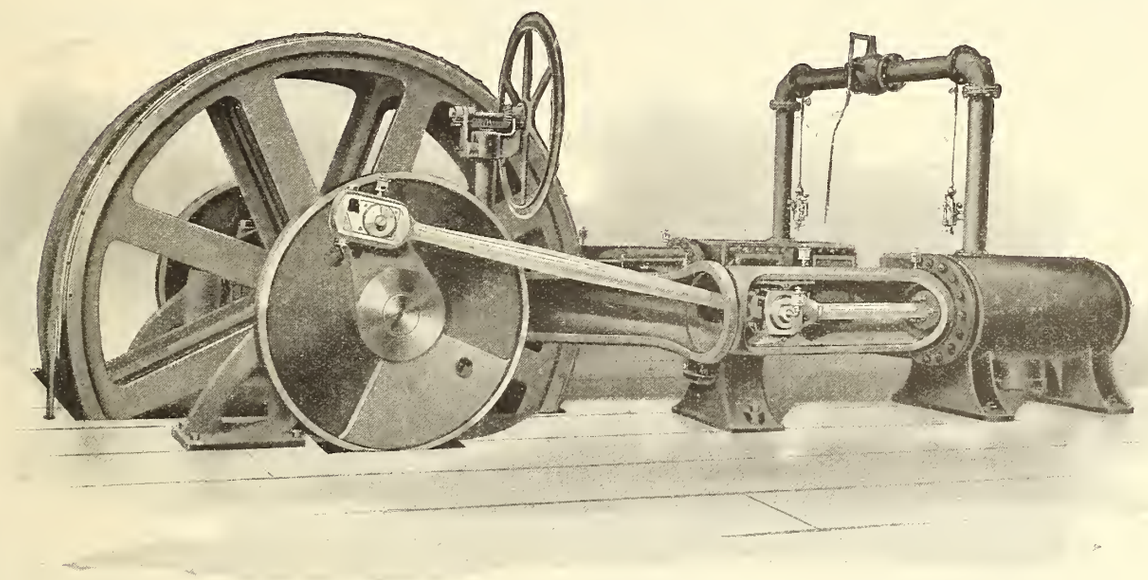
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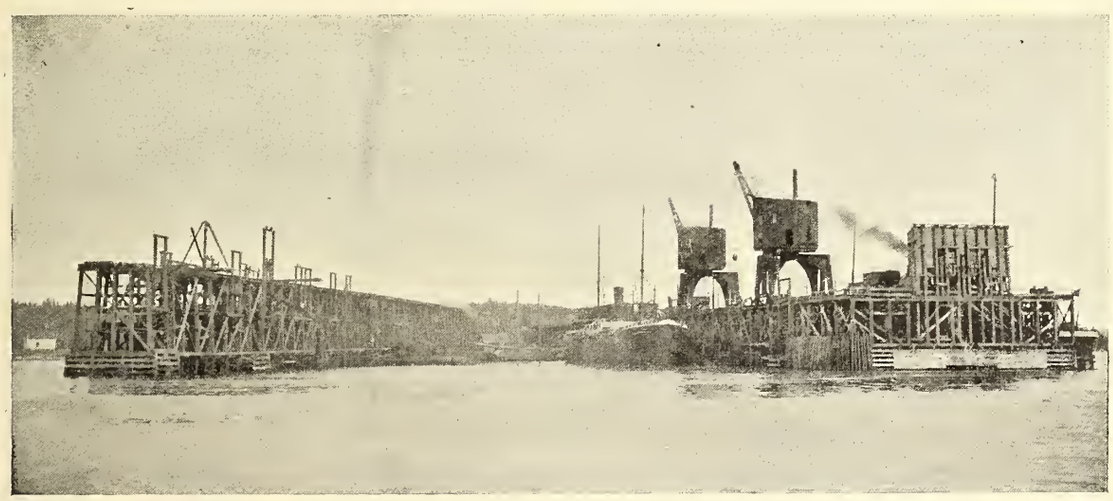
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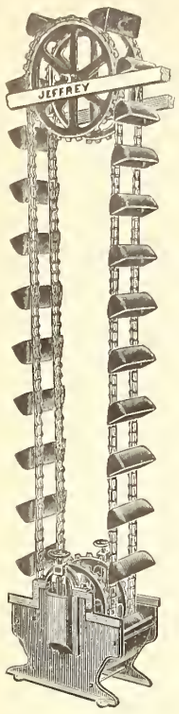
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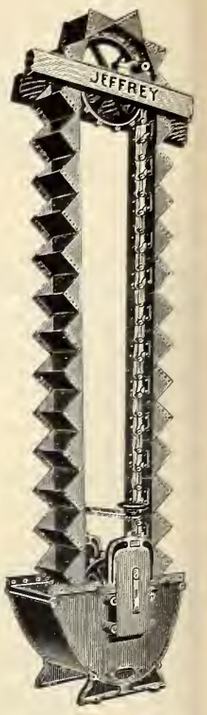
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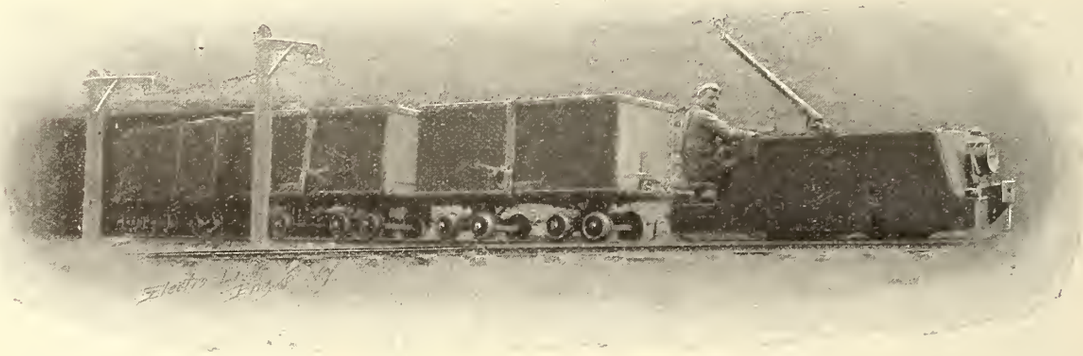
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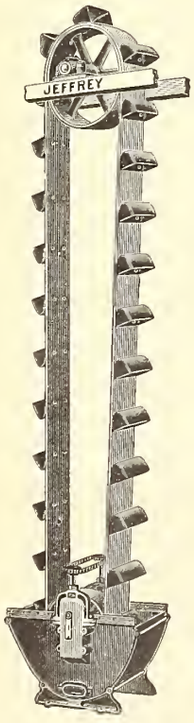
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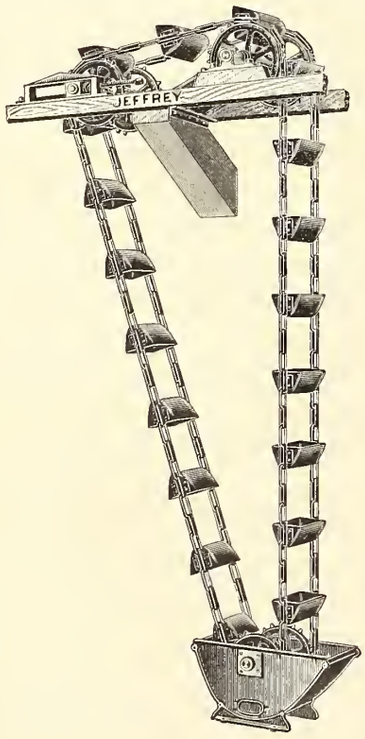
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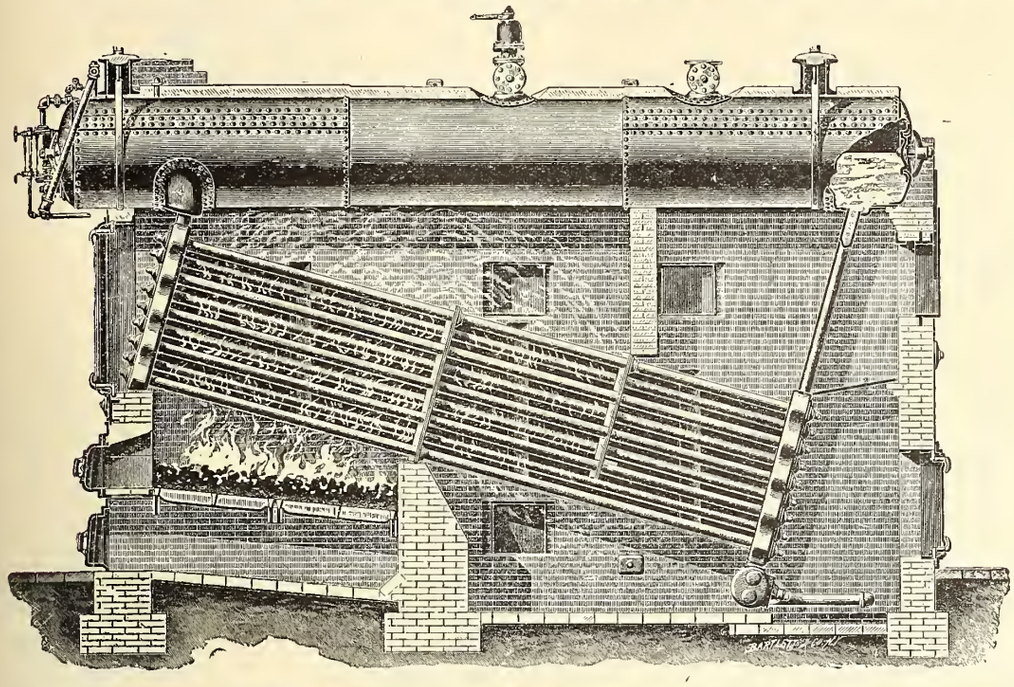


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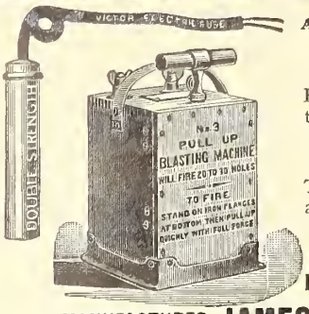
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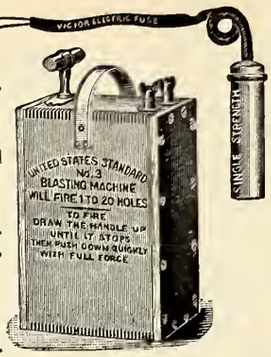
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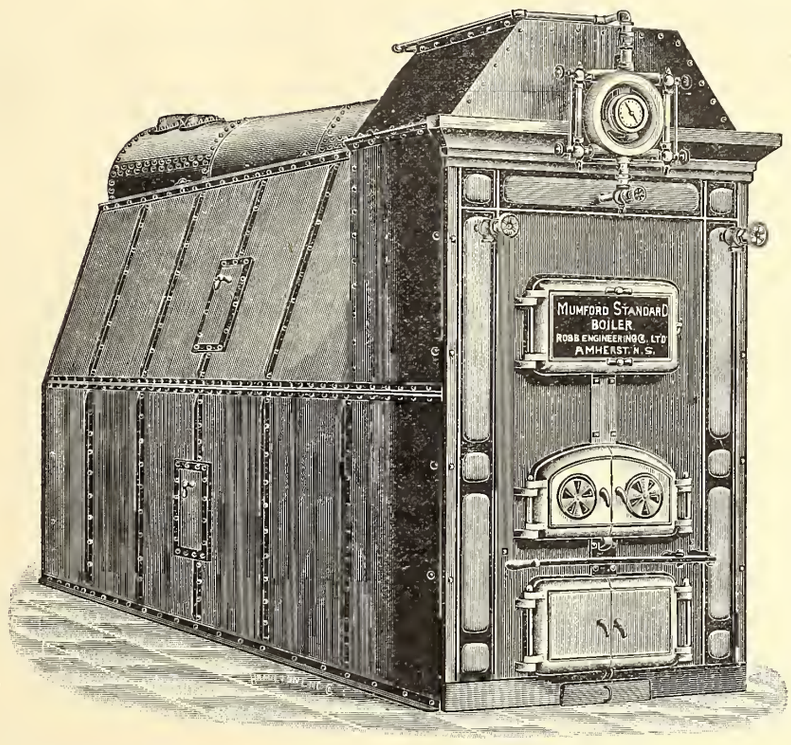
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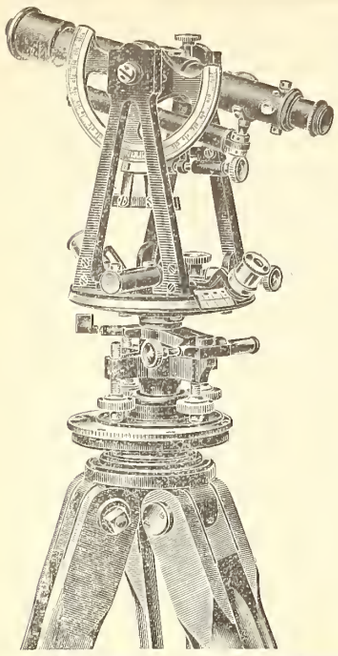
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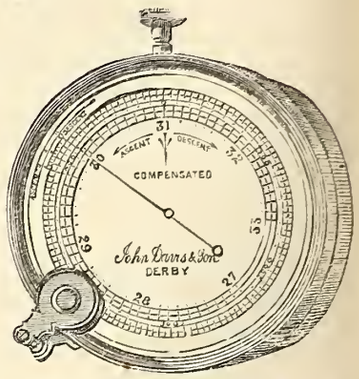
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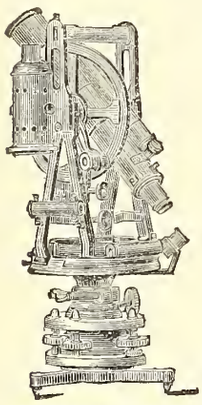
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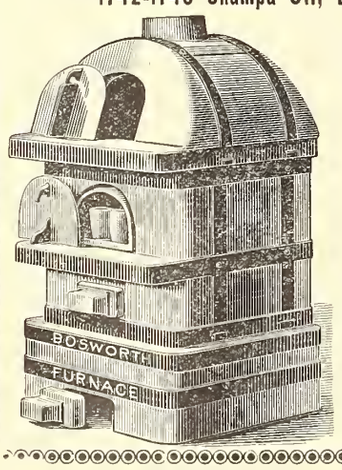
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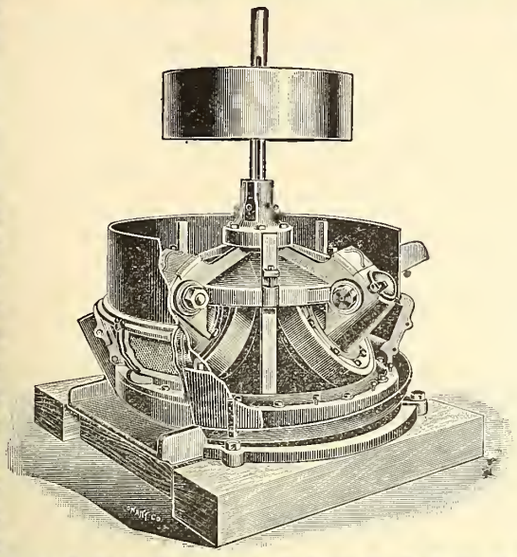
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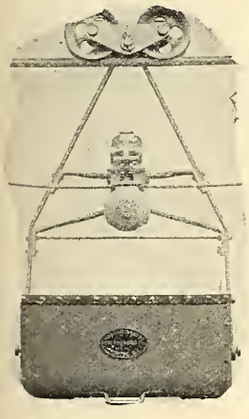
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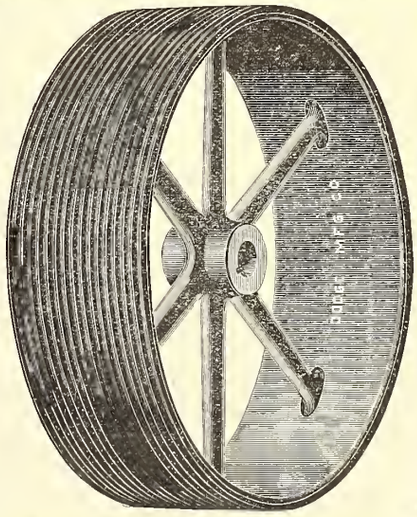
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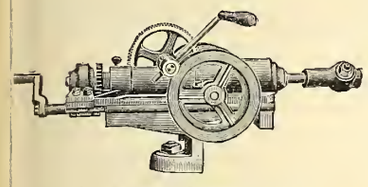
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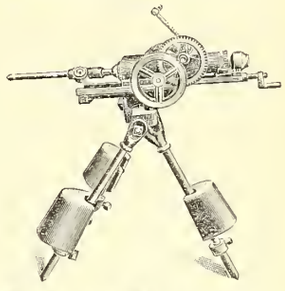
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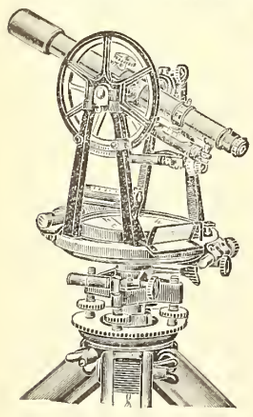
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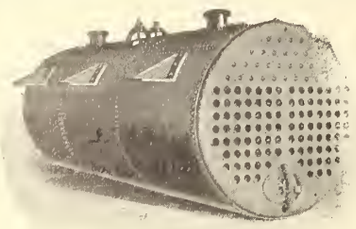
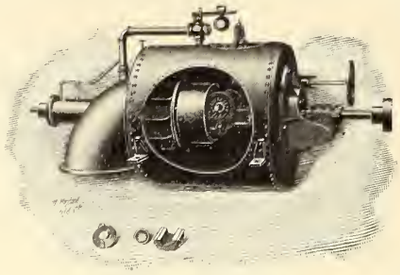
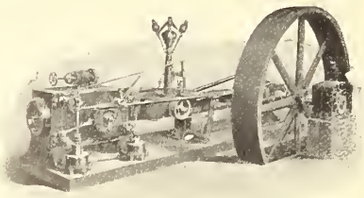
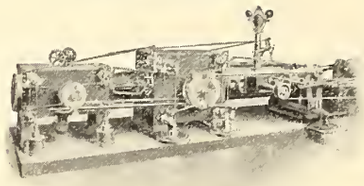
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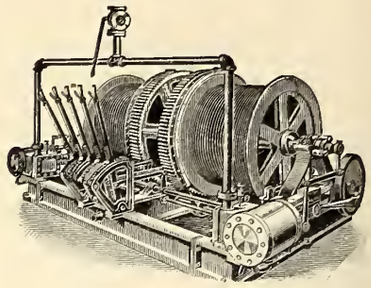
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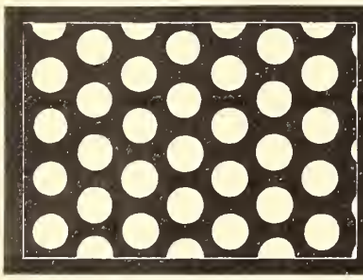
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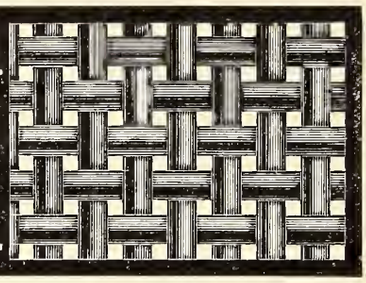
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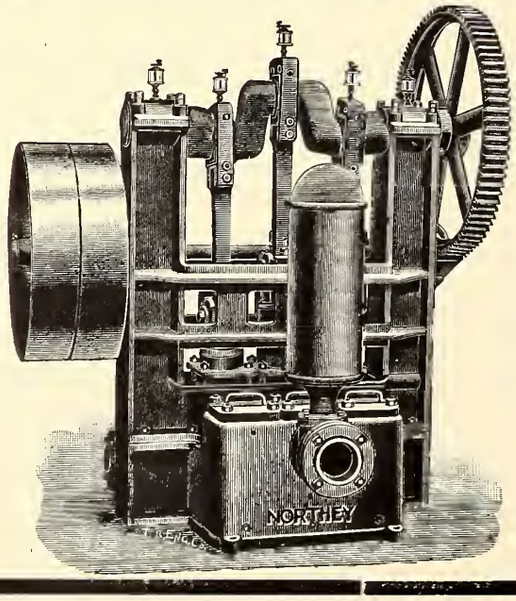
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Triplex Power Pump . . . . . .

We are manufacturing headquarters for all classes of Pumping Machinery. We have been in this business for a great many years and have given special attention to the construction of Mine Pumps. We are prepared to quote on Station Pumps; Pumps for bad Mine water; Pumps actuated by Electricity, Compressed Air or Steam; Sinking Pumps or Pumps for any special duty.

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We illustrate in this advertisement a typical Pump for Mine Work. This is our Triplex Power Pump, fitted with tight and loose pulleys as shown in cut. It is the regular Triplex type with the three cranks 120 degrees apart; crankshaft and connecting rods are of steel; gears machine-cut from the solid; plungers of brass and all details carefully worked out. This Pump is especially adapted for service with Electricity as the motor power.

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20th YEAR OF PUBLICATION.

The CANADIAN MINING REVIEW

Established 1882

THE OLDEST AND ONLY OFFICIAL MINING AND ENGINEERING JOURNAL PUBLISHED IN THE DOMINION OF CANADA.

. T. A. BELL, Editor and Proprietor.
Secretary, Canadian Mining Institute, etc.

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he Value of Topographic Maps to Prospectors and Miners.

At the Montreal meetings of the Canadian Mining Institute a ature of the discussion upon the proposed reorganization of the eological Survey of Canada into a well equipped Department of ines was the unanimous insistence by the members of greater atten- n to the production of topographical maps of mining districts. Ex- llent work has been done by the Geological Survey in this direction, it the long delays in the publication and distribution of the sheets has equently rendered them valueless to mining men. It is hoped that hen Mr. Sifton's plans are completed for the organization of his uch needed Department of Mines, special attention will be given to e topographers. New mining districts are constantly being opened ened up in Canada and almost the first requisite of the prospector d miner is a good map. Maps are also urgently required of many the older districts. Of the value of these maps to the geologist, to e engineering fraternity and to those interested in the general devel- ment of a region, Mr. B. H. Chapman contributed an excellent per to the Butte session of the American Mining Congress. De- ribing this work of the Geological Survey of the United States, Mr. hapman said:—

First—The exploration work, which is primitive in the extreme d depends upon rough sketches and notes made while travelling tween points distant one from the other, and the compilation of this ta.

Second—The standard sheets, which are the product of an actual rvey of an area in which the numerical values are completed—the easurements of horizontal distance and the elevations compared.

Third—The "special" maps of areas important to mining men, here development is in progress or to be begun.

The first of these is of more importance to the prospector, often e the only guide that he has in a new region. They are small in ale and usually cover the forest reserves and such regions as Alaska. e second and third are directly of use to the mining man.

The standard sheets are made at a scale usually of one inch to o miles, with contour lines 100, 50 or 25 feet apart, as determined the ruggedness of the region under survey, which show the relief, e slope and height of the hills and mountains and the grade of eams and configuration of the valleys. Clties, towns, roads, trails d isolated houses outside of towns and the township corners and es exactly as found are shown. These sheets are the size of a small wspaper page and include an area of about 400 square miles each.

The "special" maps show everything enumerated for the standard maps and in addition the buildings, street railways and alleys in the towns, the section corners, "quarter" corners, all mines and the important prospect holes. The interval between the contour lines ranges between 10 and 50 feet, and the scale between 800 and 2,000 minutes to the inch.

The field work of topographic mapping is of three varieties. First, the primary control, which consists of a few carefully computed points, which are located by triangulation; second, the spirit levelling, upon which depend all the measurements of heights and the contouring, and, third, the drawing, in the field, of the map upon these data, for which the plain table and telescope alidade, in connection with a telemeter rod, is used.

The standard sheets are of such accuracy that with a little experience the mining man can locate his property upon the map with preference to his elevation above sea, its distance from mountain peaks, streams or towns. He can determine approximately the length of a trail or road to his property, together with the necessary grade; the location of a mill or smelter site, the headwork and length of ditch necessary to bring him water, and the feasibility of a railroad connection should the development of the property warrant it.

The special maps may be used to better advantage for all of these purposes, but, as they necessarily cover a smaller area, the relationship of the information to distant points cannot be so well determined. Upon these maps the mining claims may be plotted or measurements made from definitely marked points on the map to croppings, or other geological features, and so the surface position may be determined.

Mining Progress in Ontario.

Mining in Ontario is rapidly developing into one of the most important industries, and, indeed, it may be said with truth that in so far as metalliferous mining is concerned, this Province has jumped into the leading position among the other Provinces of the Dominion. The production of nickel, copper, iron, arsenic, gold and silver for the first three months of the year shows an advance of no less than 52 per cent. over the same period last year. Considerable prospecting is going on and many new mines are being opened up. The greatest of these industries is unquestionably the copper-nickel mining operations in the Sudbury region, mines which for many years now have earned handsome profits to their fortunate owners; and much of the progress reported in Mr. Gibson's last report of the Ontario Bureau of Mines has been due to the extension of the operations of the Canadian Copper Company, the Mond Nickel Company and other operators in that region.

The Report of the Bureau of Mines recently issued is the eleventh since the Bureau was started, and the second since Mr. Gibson succeeded Mr. Blue as Director of the Report. It is a most excellently printed and beautifully illustrated blue book, and has the merit of giving concisely a vast amount of serviceable data concerning the mines and mining industries of the Province. It includes four excellent maps, one of the Michipicoten iron range, one of the Helen iron mine, an outline map of the Eastern Ontario Gold Belt on the scale of four miles to the inch, and also a map of part of the District of Nipissing. The last two are the work of Mr. Willet G. Miller, late of Queen's University, who has been attached permanently to the Bureau as Provincial Geologist. Reviewing the progress of mining in 1901, Mr. Gibson says:

"The year 1901 was productive of substantial progress in many branches of the mineral industry, especially in those concerned with iron, copper and nickel, the three most important products of the metalliferous mines of Ontario. Up to the present time a very large proportion of the mineral output of the Province has consisted of non-metallic substances, including building and structural materials such as stone, brick, lime, etc. The aggregate value of this non metalliferous output is growing from year to year, but much more rapid progress is being made in the production of metals, as will be apparent from the tables of production given below. The present ratio of development if maintained will soon place the value of metallic minerals annually produced in the Province in excess of that of the non-metallic products. The following figures will illustrate this point:

Year.	Total Production of Minerals	Metallic Output.		Non-Metallic Output.	
		Value.	Per cent	Value.	Per cent.
	$	$		$	
1898	7,235,877	1,689,002	23	5,546,875	77
1899	8,416,673	2,055,492	24	6,361,081	76
1900	9,298,624	2,565,286	28	6,733,338	72
1901	11,831,086	5,016,734	42	6,814,352	58

Thus, while the total production in 1901 as compared with that for 1898 showed an increase in value of $4,595,209, or 63 per cent., the metallic products increased by $3,327,732, or 191 per cent., and the proportion of metallic output to the entire value which in 1898 was 23 per cent., rose in 1900 to 28 per cent., and in 1901 to 42 per cent. As compared with 1900 the gain in the production of metals is about 100 per cent.

Of the metalliferous output in 1901, copper contributed 11 per cent., nickel 37 and pig iron 33, a total of 81 per cent. The yield of gold was 5 per cent. of the metallic product, silver 1.6 per cent., iron ore 3.4 per cent., and steel 6 per cent.

Grouping iron ore, pig iron and steel together, and making no deduction for the ore smelted into pig iron, or the pig iron converted into steel, these three products account for about 44 per cent. of the metallic output, or about 19 per cent. of the gross mineral production for the year. In 1896 the first iron ore was raised and the first pig iron made for many years, so that within five years the iron industry—that industry of prime importance—has made good progress.

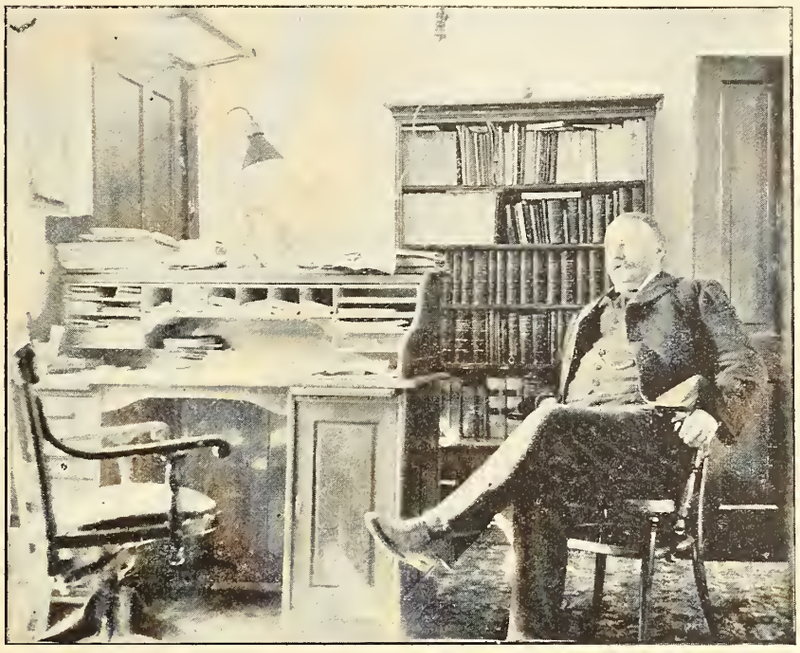
In the mining of nickel and copper, too, the advance has been marked. The output of both metals in 1901 was the largest yet reached, and owing to the more extended manipulation to which the nickel-copper mattes of the Sudbury district are now subjected previous to exportation, the product had a much larger value than ever before. Some of the mines on the north shore of Lake Huron, where the ore carries copper only as distinguished from the pyrrhotite of eastern Algoma and western Nipissing which contains both copper and nickel, are in a condition promising speedy production on a considerable scale. Indeed, one of them, the Rock Lake mine, where an extensive plant has been installed, has begun the shipment of concentrates to Michigan since the beginning of 1902. There is some prospect of a smelter being erected in the district for treating the product of this and other properties also likely to become producers ere long.

As the business of mining is carried on almost exclusively by means of joint stock companies, the formation of which under the provisions of the laws of Ontario is neither difficult nor expensive, the number of such companies organized in the Province, and of foreign corporations licensed to do business in Ontario, is to some extent an indication of the interest taken by the general public in mining affairs. That this interest has been well sustained in comparison with 1900 is shown by the fact that 47 companies were incorporated under Ontario laws with a nominal capital of $27,716,000, and that 13 companies of foreign origin took out licenses to sell stock and hold real estate in the Province, with a capital of $12,250,000; the total number of companies being 60, and the aggregate nominal capital $39,966,000. In 1900 the number of companies was 57, and the total capital $42,403,999.

But while the formation and introduction of joint stock companies is some evidence of attention being paid to mining by the general public, it is by no means a safe guide to the volume of work actually going on in the mineral industry, or even the amount of capital actually being invested in mines and used in carrying on mining operations. It must be said that the interest manifested by the non-mining public in the mining business is chiefly of a speculative character and has its origin in the hope of quickly making large returns on small investments. Many of the companies formed on the basis of undeveloped mining properties never emerge from the chrysalis state; the formal notice in the *Ontario Gazette* announcing the fact of their coming into existence being the first and last occasion on which their names are mentioned in public. Others advance a stage further and offer their stock for sale, but the rage for mining shares has for the time being passed away, repeated disappointments having brought home the truth that the road to sudden wealth seldom lies through the purchase of stock in a million dollar company the value of whose lands is entirely unknown, even though the stock may be sold at the bargain-day rates of 10 or 11 cents per dollar share.

It is a somewhat remarkable fact that metalliferous mining in the Province is almost wholly carried on by companies whose share capital is in the hands of people living in Great Britain or the United States. In nickel and copper this is true without exception, in gold it is all but true, and so also in iron. There is no objection whatever to English and American capital finding employment in our mining industry; on the contrary, capital is the industry's crying need, and is made heartily welcome from whatever source it comes, neither sentiment nor the law of the country discriminating between funds of home and funds of foreign origin. But in this, the formative stage of the business, it is a matter for regret that the people of Ontario invest so little money in legitimate mining enterprise in their own Province, and are allowing the control of what promises to be one of the most important factors in the country's development to pass into the hands of others."

Preservation of Mine Timber.—A series of experiments were recently carried out at the Altenburg Colliery, near Saarbrucken, with lime, tar and carbolineum, to determine the respective value of these as preservatives of mine timber against rot. Lime was of least value, while coal tar, although ensuring perfect preservation of the surface of the timber, had failed to protect the interior, which in every instance was found to be seriously attacked by rot. Carbolineum, however, gave excellent results, provided the timber coated had been previously barked and well dried.



THE LATE J. RODERICK ROBERTSON, NELSON, B.C.
(From snapshot taken while in his office of the London and B.C. Goldfields.)



MR. R. RANDOLPH BRUCE, M.E., WINDERMERE, B.C.
(From a snapshot taken in his office at the Paradise Mine, East Kootenay, B.C.)

Profits of Gold Dredging in New Zealand.

Mr. C. E. Turner contributes to a recent issue of the *Mining Journal* a short article describing gold dredging on the Matakita River, New Zealand, in which he gives certain figures of costs and profits which are certain to be of interest to Canadians who are now giving greater attention to this promising industry on the Saskatchewan and other rivers in Western Canada. Mr. Turner says:

"That the industry is profitable, if properly conducted, is evident from the following figures:—The nominal capital of a company need not exceed £12,000. This acquires the claim, buys new dredge complete and stores sufficient for six months:

Costs of working:—

	Per week.
Dredge master	£ 6 0 0
Engineer	4 0 0
Two drivers at £3	6 0 0
Three winchmen at £3	9 0 0
One general hand	2 10 0
Labor	£27 10 0
Stores, &c.—	
Firewood or coal per week	£12 0 0
Lighting and lubricants, &c	1 0 0
Wear and tear	16 0 0
	£29 0 0
Plus labor	27 10 0
Total	£56 10 0

Gold at £4 the ounce=14 ounces 2 dwts. 12 grains.
Say 14 ounces to cover expenses.

Usually the engineer takes either the morning or 4 p.m. shift, so that the machine runs the whole 24 hours.

It will readily be seen that a dredge capable of handling 1200 cubic yards per 24 hours (which is a small amount) of wash that will average only two grains per yard will pay a good dividend, thus 1200 yards at 2 grains=2400 grains=100 pennyweights=5 ounces per day of 24 hours=in one week 30 ounces at £4=£120, less working costs £56 10s., gives £63 10s. profit, which=£3302 per annum. Deducting £302 for secretary and office expenses, there remains the handsome profit of £3000, or 25 per cent. on the nominal capital of the company."

Oil Concentration for Low Grade Ores.

At the moment some attention is being directed in British Columbia to the introduction of the Elmore process of oil concentration whereby it is thought a very large tonnage of low grade ore in the Rossland, Slocan and other camps, now unavailable, may be made marketable. While it is extremely doubtful that this process will achieve for Rossland what the promoters claim for it, experiments with the process in a modified form seem to point to its successful application in some of the other camps. The process is the outcome of experiments at the Glasdir Copper Mines in North Wales extending over a period of some two years. At the outset laboratory tests and tests on a small working scale were tried, and these proving successful a plant was erected capable of treating 100 tons a week, and subsequently this was increased to 250 tons a week. Something over 3,000 tons of various ores have been treated so far and now the owners are branching out and propose to do business on an extensive scale.

Over 52,000 tons of ore treated at the Glasdir mine under the supervision of capable managers and with a modern up-to-date plant—water concentrator—resulted in the average value of recovery of only 14.5 per cent., while under the oil process over 80 per cent. of the metallic values have been obtained after working on a fairly large scale. If the process is commercially successful it means much to the mining camps across the border and will be installed on a number of mining properties during the coming year.

The process is shortly described as follows:—The rock from the mine, after passing through the usual stone-breakers, is crushed on a pair of Cornish rolls and run thence to two Huntingdon mills, where it is reduced to pass through a 30-hole screen and issues therefrom with just sufficient water to make it into a freely flowing pulp. From the Huntington mills the pulp passes directly into the open end of a horizontal rotating drum, inside of which is fixed a helix with crossed blades or buckets, which lift up the pulp to a certain height and drop it again, at the same time propelling it forward to the opposite end of the drum, thus keeping the pulp in constant agitation for the few seconds which are occupied in its progress through a drum. With the pulp is also admitted a small quantity of thick, sticky oil (the residue left in the drills in the refining of paraffine oil).

This oil is, of course, subjected to the same agitation as the pulp and is consequently tumbled about with it and exercises the remarkable property of sticking to and buoying up the particles of mineral that are floating about or suspended in the pulp; but it does not stick to or have any effect whatever upon the particles of rock which are present in much greater number. The oil and pulp automatically discharge from the opposite end of the drum into a pointed box or spitzkasten in which the tailings at once settle down and flow off with the water at the bottom, while the oil, by reason of its buoyancy, floats to the top and carries up with it practically all the values which the ore contained. From the top of the box the oil with its load of mineral flows off continuously to a specially constructed centrifugal machine, where the oil is extracted from the mineral, which is left in the machine, the oil being at once ready for reuse.

Phosphate Output.

While the production of Canadian apatite no longer occupies any prominence in the mineral statistics of the Dominion, the whole output having dwindled to a few thousand tons annually, mainly from the mica mines of certain portions of Ontario and Quebec, figures of the production of phosphate rock across the line are still interesting to many readers of the REVIEW.

The total production of phosphate rock in 1901, as reported by Dr. Joseph Struthers, in "Mineral Resources of the United States, 1901," now in press, United States Geological Survey, was 1,483,723 long tons, valued at $5,316,403, as compared with 1,491,216 long tons, valued at $45,359,248, in 1900, a decrease of 7,493 in tonnage and $442,845 in value.

The industry in Florida, which has been the chief producing State since 1894, continued to show an improvement, the total output and value for the State in 1901 being the largest yet recorded. The production of hard rock and land pebble was greater than in 1900, though the quantity of river pebble was appreciably less than the output of the previous year, and but slightly greater than one-half that in 1889. The increase in the production of hard rock and land pebble more than offset the large decrease in the quantity of river pebble produced, so that the total production of phosphate rock in Florida during 1901 was greater than in 1900, being 751,996 long tons, valued at $3,159,473, as compared with 706,243 long tons, valued at $2,983,231, in 1900. Soft rock has not been produced in Florida since 1897, in which year a small output of 2,800 tons was reported.

In South Carolina there was a slight decrease in the output of long rock, which was nearly offset by the increased output of river rock, the total being 8,000 long tons less than in 1900; the respective

outputs reported are 225,189 long tons of land rock in 1900, as compared with 266,168 long tons of land rock in 1901, and 95,992 long tons of river rock in 1901, as compared with 62,987 long tons in 1900.

The total output of phosphate rock in Tennessee decreased from 434,191 long tons in 1900 to 409,653 long tons in 1901, equivalent to nearly 10 per cent. decrease.

The average price per long ton of Florida hard rock continued practically the same as in 1900, being $5.23; the price of land pebble decreased from $2.77 in 1900 to $2.67 in 1901; and the price of river pebble declined from $2.36 in 1900 to $2.25 in 1901.

The price of South Carolina hard rock in 1901 was $3 18 per long ton, as compared to $3 30 in 1900, and the average price of river rock was $2.56 in 1901, as against $2.61 in 1900.

The Mineral Grants of Nova Scotia.

Owing to the prominence given to gold and coal mining in Nova Scotia it is generally believed that all the minerals are reserved to the Crown. This is far from being the case, and the history of the mineral reservations in the land grants forms a chapter at once useful and important.

Practically speaking the English settlement of Nova Scotia began when Lord Cornwallis founded Halifax. The lands bordering the Bay of Fundy, so long occupied by French settlers, became an early object of attention. The Government, anxious to settle them with British subjects, invited immigrants from Maine, Massachussets, Rhode Island, etc. Coming in companies, township grants were laid out for them. We thus find the townships of Newport, Windsor, Annapolis, Granville, etc. In these, among the earliest grants, we find that sometimes only the royal minerals, gold and silver, were reserved, together with pines for the king's ships; in other grants, copper, lead and coals were reserved. Later grants were issued with the reservations somewhat increased. After 1808 iron was almost invariably reserved.

Much space would be required to give these variations in detail, and now no record remains of their causes.

In the island of Cape Breton, which seems to have been largely governed on the principle that the settlers were best served by leaving them alone, large tracts were occupied by settlers who received no grants. In many cases leases were given of lands subsequently legislated into fee grants.

Finally in 1826 the Crown of England granted to the Duke of York all ungranted minerals in Nova Scotia. So carelessly was this done that for some time doubt remained as to his title to the minerals in Cape Breton.

In the year 1858 this monopoly was terminated. The assigns of the Duke of York, the General Mining Association of London, retaining seven valuable tracts of coal lands, relinquished their rights to the remaining minerals. By an Act passed in the same year the Legislature of Nova Scotia undertook to define the position of the rights so relinquished. In the Act it was stipulated that in all Grants passed between 1826 and 1858, which necessarily did not convey any minerals, the Crown would reserve only gold, silver, lead, copper, tin, iron, coal, and precious stones, and that the grantees should possess all other minerals. Further, it was stipulated in future Grants the reservations would be the same.

This legislation continued in force until 1892 when the reservations were extended to include all minerals except gypsum, limestone and building materials.

As, in addition to coal and gold, the mineral list of the province contains manganese, barytes, gypsum, iron, marbles, dolomites, etc., it will be seen that important sources of revenue have been lightly overlooked.

In many countries where the descent and ownership of land is a matter of interest and importance, the titles under these grants would have given the present proprietors promise of mineral wealth. The early settlers, however, in some cases never occupied their allotments, or after a brief settlement sold or abandoned them. Frequently they were succeeded by squatters or by later grantees.

It thus happens that grants of all ages are mixed together, and are now presented divided and subdivided, so that in too many cases no clear title can be traced either to the land or to the mineral.

These evils excited but a passing notice for many years. Now, however, they meet the prospector at every step. The development of the iron ores of the province, at this moment of great interest in view of the manufacture of steel and iron in Cape Breton. In many grants where the allotments were taken up and remain in possession of the descendants of the original grantees no difficulties are met. This is noticeable in the grants around the Bay of Fundy as in the townships of Londonderry, Truro, Nictaux and Amherstport. In the older settlements, however, in the poorer parts of the province, speaking from a farming point of view, this is seldom the case, and large tracts are met to which a clear title cannot be found.

Judging from opinions given some years ago by the ablest legal authorities, it is questionable if the effect of these grants can be construed to permit any method of escheat. It would be immeasurably to the benefit of the public, as well as to the occupant of the land, If some scheme could be devised by which clear rights of entry and search as well as indefeasible rights of mining could be obtained. This subject is one worthy of the careful consideration of the Government in the interests of all concerned. As it would seem impossible to fix the rights to the minerals clearly to permit in all cases of a good title, it might be necessary for the Legislature to condemn all mineral rights not reserved, and not under form of option or purchase for working.

By this means clear and easily obtainable mining rights would be secured. The occupier of the lands should in such case receive for his rights, such as they may be, a share in any royalty levied by the Government.

Enquiries Respecting Molybdenite.

Messrs. Chas. Hof & Co., 52 Leadenhall Street, London, E.C., write as follows:—

"To-day we would like to enquire whether you can offer us molybdenite, which we understand occurs in large deposits in Canada and British Columbia. Perhaps you are aware of some of these, and f you can make us the offer of regular supply we are prepared to contract for the regular delivery of about 50/60 tons monthly, and at the present time, are ready to pay 10d. per lb. delivered c. i. f. Hamburg, or a proportionate amount for delivery f. o. b. Montreal or other port having steamer connection with Hamburg.

We further beg to say that we make a specialty of rarer minerals, such as Monazite Sand (Thorium), Vanadium, Wolfram, Rutil, etc., and we shall be pleased to receive your offers, which must be accompanied by samples and analyses, if you are in a position to supply."

Mr. S. Dillon-Mills, Toronto, writing upon the same subject, says:

"One great want in connection with our undeveloped mining sections appears to be that of an accurate knowledge of the commercial value of the less common minerals, and even of such as mica, talc, soapstone, marble, graphite, etc. There is a good deal of enquiry for molybdenite, the value of which is stated at various figures ranging from 33c. to $1.25 per lb. for the clean ore; now, with 50 per cent. ferro-

molybdenum quoted at $1.25 per lb., either of these extremes appears absurd. If the price was definitely known many small deposits would be worked by the owners, who are now afraid to touch them. Could you not add to the value of your excellent REVIEW by giving prices current or approximate values of these and the rarer ores of which no mention is made in trade journals, *e.g.*, pitchblende, wolframite, etc.?"

Some Reflections Upon the Coal Strike.

Now that the strike is practically ended, it will be well to study some of its features in relation to Canada. Our country is so intimately associated with the United States in social and economic matters that any great disturbance in the latter is soon reflected into the former. This has been, one may say, strikingly exemplified lately; and the scarcity of fuel in Canada raises the question as to whether our present dependency upon the United States coal operators is a necessity. Is it possible that we may learn to do without Pennsylvania anthracite? Are we even now finding out that we can do without it? Anthracite owes its advantages as a fuel to the facts that it burns without smoke, that it is so hard as to suffer little loss as slack in handling, and that it is compact enough to burn slowly and very regularly. For these reasons it is the favorite fuel of the householder wherever it can be bought at a reasonable price; it is preferred in cities where soft coals, when used, cause the heavy pall of smoke with which Londoners become so familiar in damp weather, when it descends upon and almost suffocates them; and even for generating heat on the large scale it may be more economical than soft coal under certain conditions. But soft coal can be used in such a way as to avoid smoke. It may be converted into coke which can compete with anthracite in most respects. The New England Gas and Coke Company of Boston, formerly a struggling concern, is now reaping large profits from the rapid sale of its coke, and many consumers are finding out for the first time how good a substitute it is for anthracite. In the conversion of bituminous coal into coke, gas, ammonia, and coal tar are obtained as by-products. This well known industry is only in its infancy in the United States and in Canada. The demand for ammonia is sure to grow as intensive farming extends. The time will come sooner or later when both countries will manufacture their own coal tar colors and synthetic medicines. The demand for coal tar will thus increase. The consumption of gas for heating purposes has enormously increased during the strike. Thousands of householders who have become accustomed to this cleanly convenient fuel will stick to it. With all these influences growing in favor of the coking industry is it too much to hope for coke cheap enough to compete with anthracite?

At this point let us take stock of our resources in coal. The only place in the Dominion where anthracite is being mined is from the comparatively small deposit at Anthracite in the West. As anthracite is the rarer form of coal we can hardly hope for any extensive discovery in the future. We are, however, richer in the bituminous varieties of coal. Nova Scotia will be a large producer for an indefinite period. Cape Breton is by no means completely explored; and the recent extensions of the coal areas in the Springhill district by the work of Mr. Hugh Fletcher are significant. In New Brunswick some small deposits of coal are known to exist, and one at Grand Lake on the St. John River is being worked in a small way. But going westward we pass over a hopelessly coalless region until we reach Manitoba. The lignite of the Souris Valley is being extensively used by the railways to which it is easily brought. It is spoken of by railway men as a good locomotive fuel. Other and large deposits of brown coal are known in the Northwest. British Columbia is well provided with bituminous coal. The coal problem is then most difficult in Ontario and Western Quebec; but even here the situation is by no means hopeless. With the completion of our great waterway from the west end of Lake Superior to the Atlantic we may hope to see steamers running between lake points and Atlantic seaports. A demand in Cape Breton for the iron ores of Michipicoten, of Nipissing, and of Eastern Ontario would bring about an exchange for Cape Breton coal and coke which as return freights could penetrate much further inland than they can at present be profitably carried. Another possibility, (one would like to write *probability*), for Ontario is the discovery of coal in the regions about James's Bay, believed by our geologists to be of the right horizon. Should such a discovery be made, the distance of Central Ontario from the nearest Canadian supply of coal would be cut in two.

The strike has also directed increased attention to peat fuel, large quantities of which are made and used as briquettes in Europe. A large number of investigators are working at the problem of converting peat into a hard, compact smokeless fuel, with a maximum of valuable by-products. One ingenious experimenter (Jebsen) has even introduced a retort heated by electricity, so that the temperature can be very exactly controlled. In this way he has succeeded in making a good fuel and in saving by-products much resembling those from coal, but with a larger yield of paraffin wax. Jebsen's process may not be so unpractical as its use of electricity for heating purposes might seem to make it. An easily developed water-power, a handy peat-bog, and a good market for by-products are factors to be considered. Nature has been particularly kind to Ontario and Quebec in regard to peat, although she has neglected their coal interests. In both these provinces, as well as in Nova Scotia, in New Brunswick and in British Columbia, there are extensive peat bogs. They are particularly abundant in Ontario, where the archæan rocks, of varying hardness and resistance to erosion, have been glaciated into numerous comparatively small basins, in many of which having no large outlets water has collected and bogs have formed. The Ontario Bureau of Mines has had in hand for several years an investigation into the extent and character of its peat bogs, and the best methods of making them available. We await with interest the publication of the report. In the meantime, peat is being made into briquettes at Beaverton and sold at $3.25 a ton.

Wherever population is dense enough to make feasible the manufacture and distribution of gas we may hope to see its use extended both for heat and for power, provided it can be made from cheap raw material. In many of our towns and cities immense quantities of waste wood are being burned or in other ways disposed of at an actual expense to the lumberman. Dr. James Douglas of New York has so modified the Allis-Pettibone gas producer as to adapt it to wood; and he expresses the opinion that a further modification will enable us to use it for saw-mill refuse. Gas engines have been so improved that they are now made up to one thousand horse power. This puts cheap power within the reach of manufacturers who are within easy range of a saw-mill.

Another form of power unusually abundant in Ontario and Quebec is that of waterfalls and rapids. It is safe to say that no country upon the face of the earth has been equally favored. Ottawa alone has one million horse power within a radius of forty miles. The transmission of water power by compressed air and by the electric current has been very much improved, and the loss is now quite small. The range of the electrical transmission of power is becoming continually wider. Thus, so far as power is concerned, Ontario and Quebec may become largely independent of the coal operators and of coal strikes, as soon as the manufacturers learn to group their factories around the easily

available water powers. In fact, recent developments at Sault Ste. Marie, Shawinigan Falls and other places show that the lesson has been already learned. We are glad to note, by the way, that the coal strike was dodged at the Cordova mine (the greatest gold mine in Ontario) by the completion just in the nick of time of the compressed air line from Deer Lake Falls.

It is doubtful if the electrical current, even when generated by water power, can ever compete with a cheap fuel for heating purposes. Its use in this way will in all probability remain among the luxuries so long as present conditions prevail. In order to compete with coal the current must be generated at something like seven or eight dollars per electrical horse-power (24 hours). But the solution of a problem which at present seems almost insoluble, would completely change the situation We refer to the direct conversion of the potential energy of coal and charcoal into electricity. As is well known, the best engines convert into power only about twenty per cent. of the heat received, and this does not take into account the loss by way of the chimney. We may consider that the limit of efficiency has been pretty nearly reached. The average loss is very much greater than that mentioned; so that the discovery which awaits some fortunate investigator might reduce the cost of the electric current to about one-sixth of its present cost when generated by a steam engine. Under these circumstances heating by electricity might become economical.

When Does a Miner Start Work?

A case of considerable interest under the Workmen's Compensation Act was recently heard before Judge Gwilym Williams at the Mountain Ash County Court, South Wales, in which John William Matthews, a collier employed by the Penrikyber Colliery Co., sued his employers for nine weeks' compensation, at the rate of 13s. a week, for an accident which had occurred within the colliery yard, but before the applicant had obtained his lamp from the lamp station. Applicant said that on March 6th he was going to his work at the Colliery. He had turned off the main road into the colliery premises. He was going for his lamp along a tramline, in company with another man, and to avoid an escape of steam he turned aside and fell, and broke his arm, and was out of employment until May 8th, and he claimed 13s. a week. The lamp station was a few yards away, and the lamp was then handed him locked and examined. Getting his lamp was his first duty. Mr. Bertram (for the respondent) urged that until the man obtained his lamp his employment had not begun, and he quoted the case of a man being on the railway leading to the colliery. His Honor said that his view was that the deduction from the decisions of the various courts was that the moment the man got on the colliery premises for the legitimate purpose of entering on his duties the company was liable. Judgment was given for the applicant for the amount of claim with costs.

CORRESPONDENCE.

To the Editor of THE REVIEW :—

SIR,—The publication in many papers of the text of Mr. E. B. Kirby's paper on "The Influence of Government on Mining," presented at the Nelson meeting of the British Columbia branch of the Canadian Mining Institute, is my warrant for asking you to publish the comments which follow; at the same time I desire to express the hope that the paper will be discussed at a *full* meeting of the Institute before it is permitted to be printed in the Transactions.

Knowing, personally, Mr. Kirby's ability as a mining engineer in Colorado before he was called to British Columbia, and recognizing fully the difficulties, both economical and technical, which he has encountered in the exploitation of the War Eagle and Centre Star properties, the writer has deeply regretted the biassed or uninformed view which Mr. Kirby seems to have taken in dealing with the complex subject of mine taxation.

Mr. Kirby starts his paper with the statement that "Mining is almost everywhere a favored industry," and then proclaims a uniqueness for British Columbia mining because that province not only neglects to further the industry, but imposes "difficulties" which overshadow all the other problems which mining men have to face and meet there, or elsewhere. Further perusal brings out the fact that *all* of these "difficulties" are not originally of *Provincial*, but some are of *Dominion*, origin, and his bald statement that the Government taxation is twenty per cent. of the gross value of the yield is misleading, and is not verified on investigation

In his generalities, Mr. Kirby is unguarded, and the writer thinks he assumes what is quite unproved, which is not permissible to a mining engineer of Mr. Kirby's reputation. The "increasing paralysis" of the mines of British Columbia is ascribed solely to two causes, excessive taxation and oppressive legislation. That British Columbia has suffered from constant change of government, and from a general ignorance (on the part of its legislators) on the subject of a reasonable treatment of its mineral resources, can not be denied by any one at all acquainted with the history of government in that province during the last six years. But that the mines are in a condition of increasing paralysis, because of *oppressive taxation* alone, is as untrue as the former statement is true; other factors are patent.

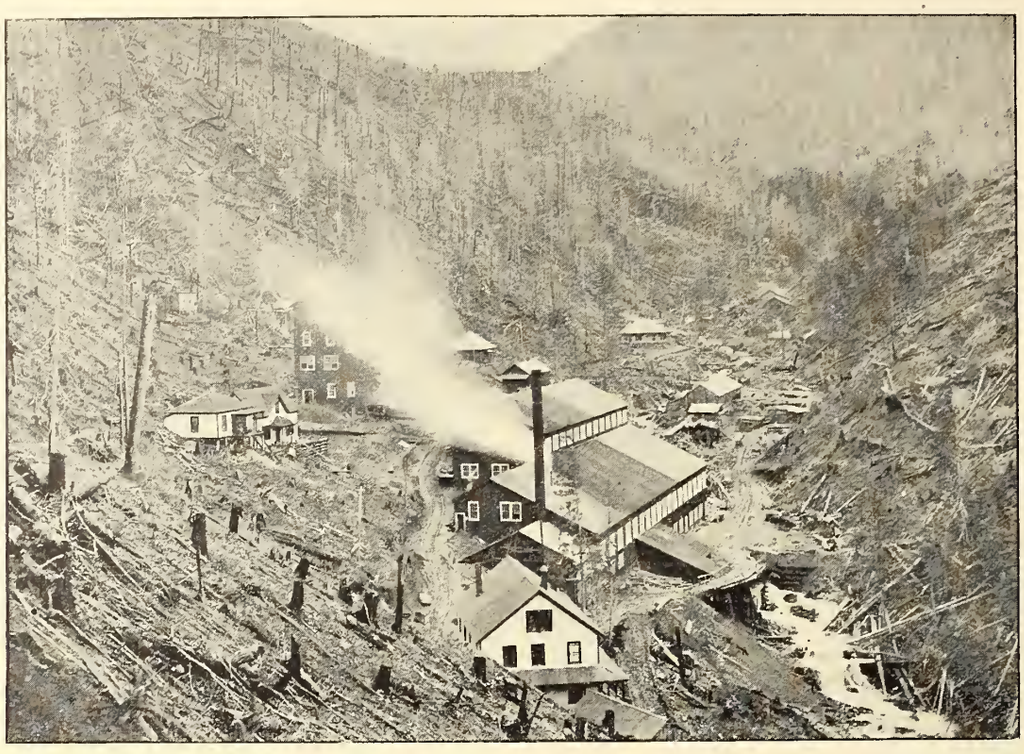
Mr. Kirby gives some figures which need comment. From the year books he finds the total value of all products in British Columbia to be about $27,000,000, of which the metal mine products (figured as Mr. Kirby says "fictitiously" on New York values and not on actual local value) amount to $15,000,000, or 55 per cent. of the whole. He then states that the "actual taxes collected amount to $5,350,000," or 20 per cent. of the total value of *all* products, and goes on to say that (by thimble rigging) the actual burden is shifted from some other industries to the mining industry, and that it "*probably*" approaches 30 per cent. of the "fictitious" value of the metallic products.

A little study of official figures and documents which have been published by the British Columbia Government will show Mr. Kirby that the total *taxes* paid to the Government in any one year from mining have never yet reached the sum of $1,000,000, or have never amounted to 7 per cent. of the total "fictitious" values produced; a little learning is a dangerous thing, and special training, if not natural aptitude, is required to make a competent statistician, or critic of statistics. Imposts levied by the Dominion Government, and Provincial taxes, are all lumped together in this paper, as they were in the discussion which followed the paper.

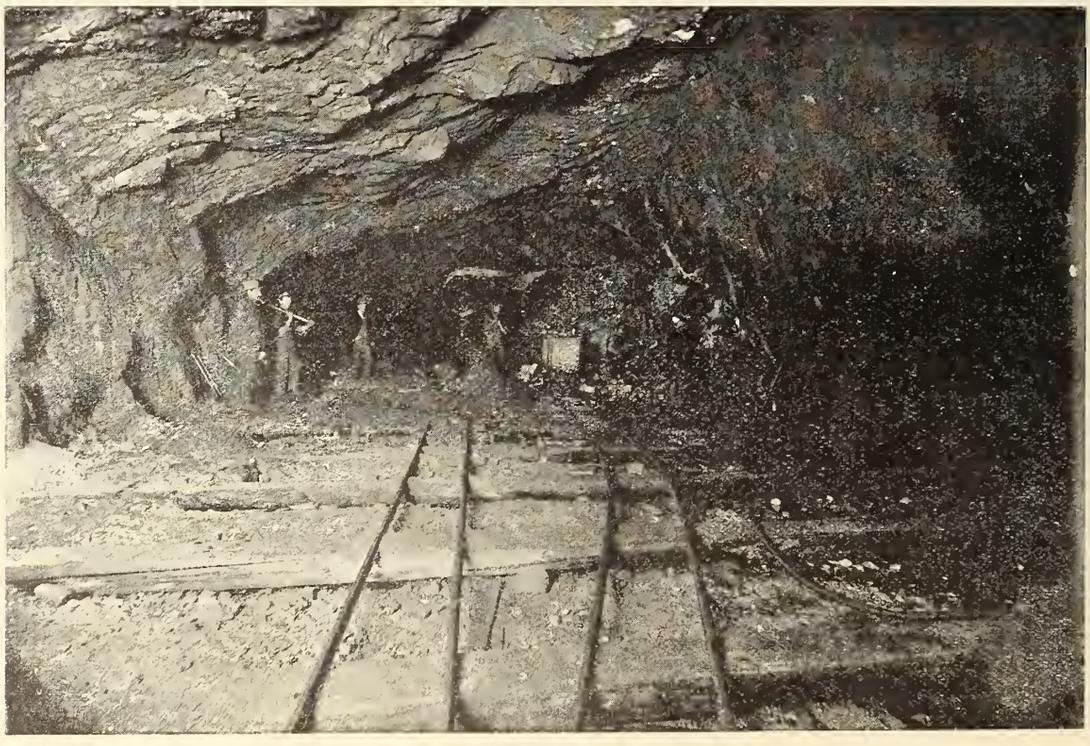
The direct taxes on mining are few; the 2 per cent "mineral" tax on output is the chief one, for "Free Miner's Certificates," licenses, fines, forfeitures, &c., &c., are more of a tax on the individual than on the producing mines, and tariff dues are Dominion and not Provincial.

Taking all indirect taxes as well as direct ones, it may be possible that, of the whole amount of revenue derived from *provincial taxation* by British Columbia the metallic mining industry pays nearly one-third, but if this is so (and it would take an expert statistician to correctly obtain the amount) the percentage of the output would only be between 6 and 7 per cent.

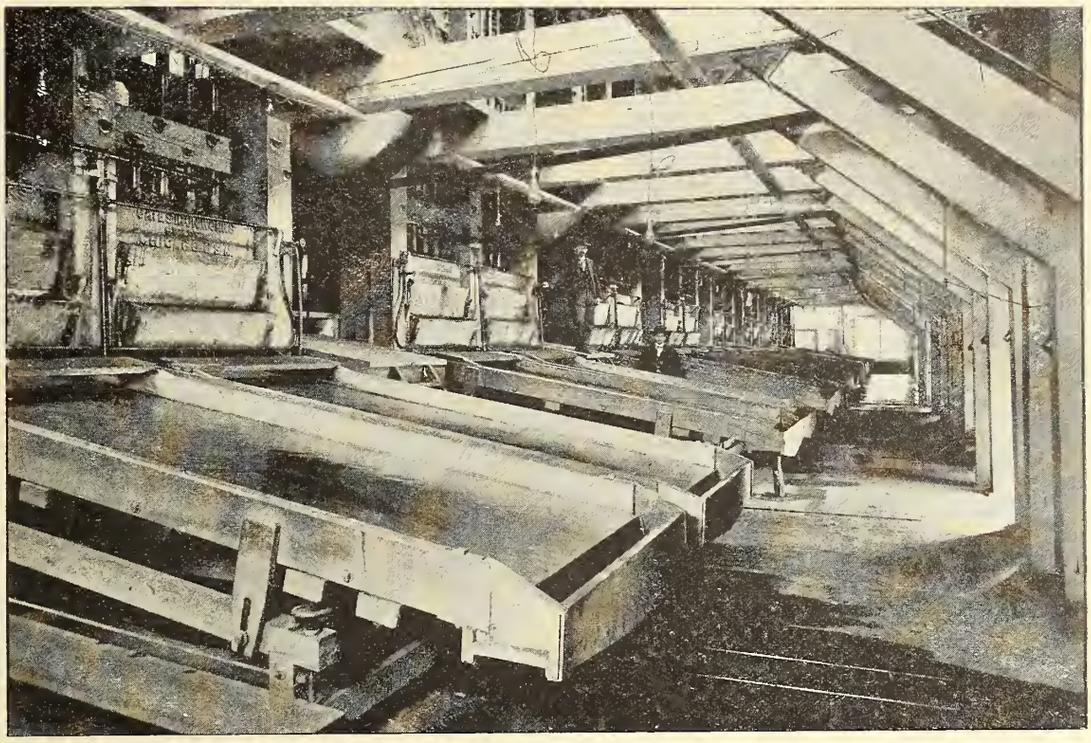
The trouble with this article, Mr. Editor, is two-fold: firstly, that Mr. Kirby's justifiable anger against the Provincial Government of British Columbia has led him to make a number of statements which he will undoubtedly be willing to revise, on suggestion; and secondly,



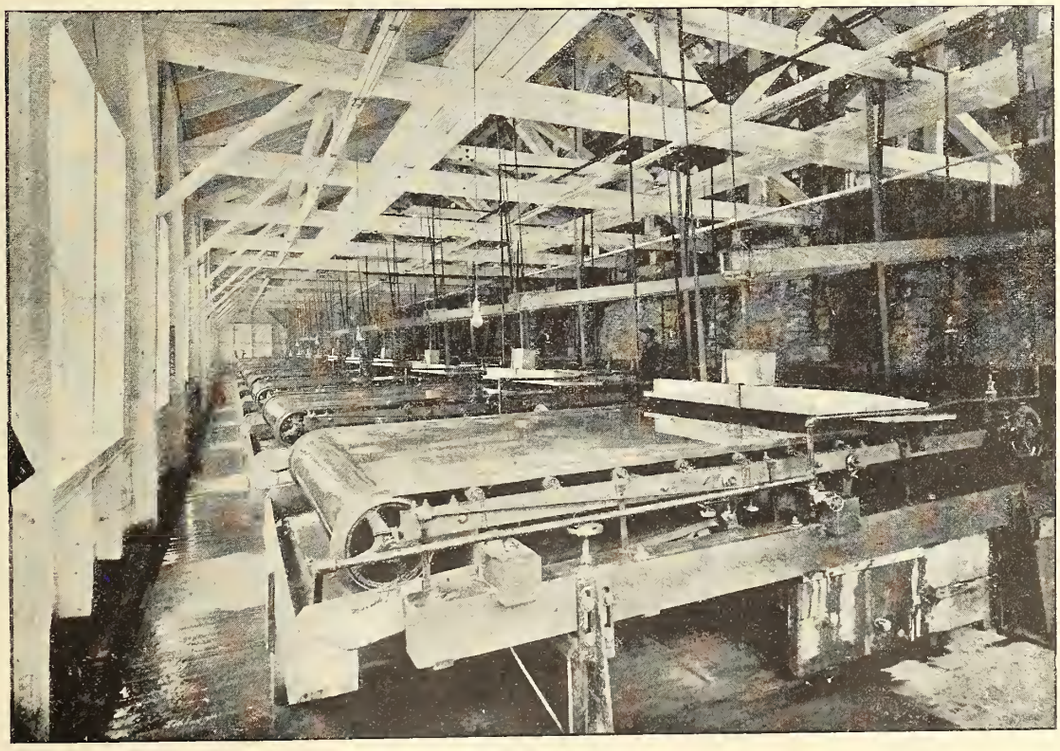
General view of the 80-stamp Battery, Cyanide Works and Mine Buildings of the Ymir Mine, Ymir, B C.



Ymir Mine, B C.—Showing Stope before timbering No. III Level. Width 42 feet.

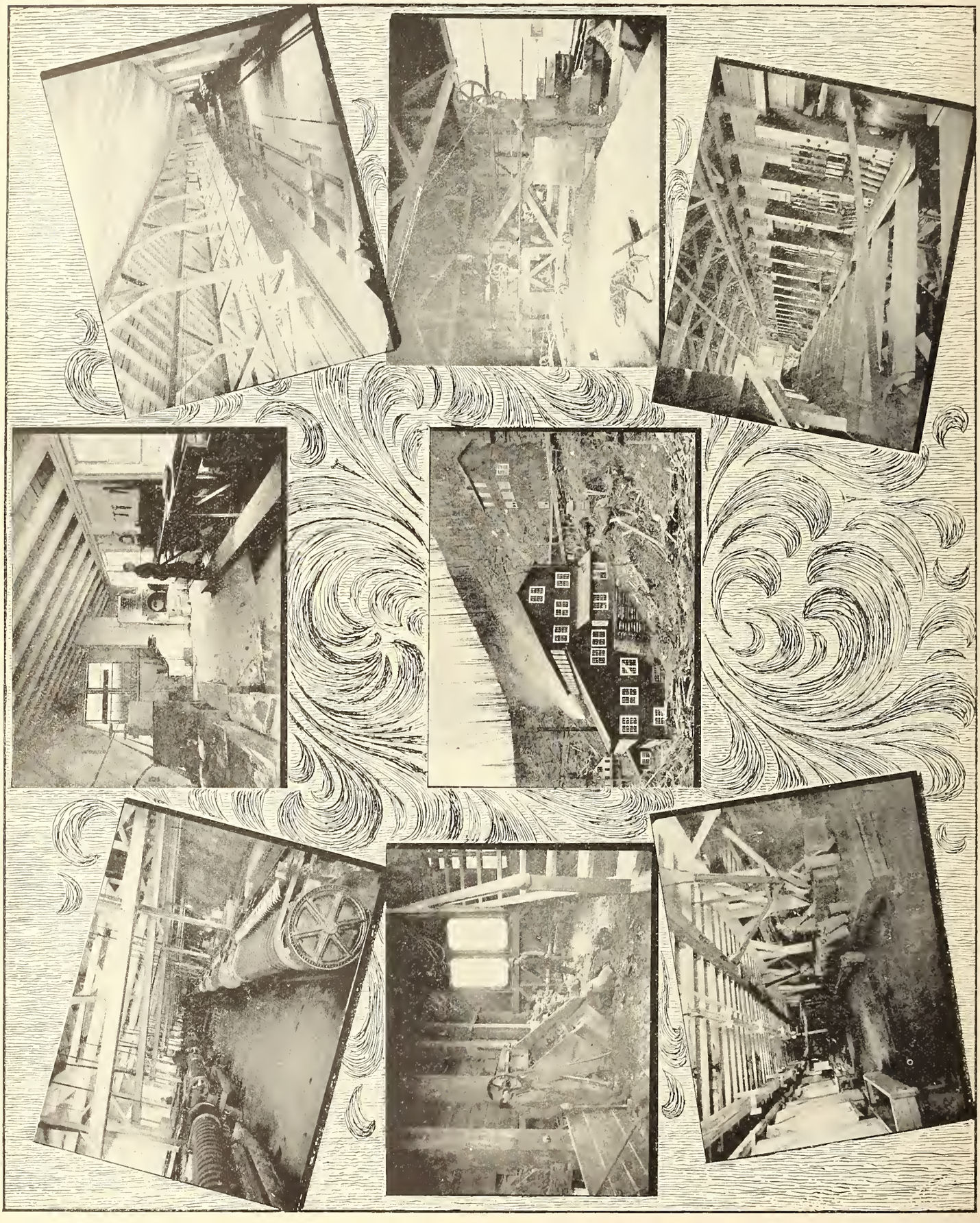


Ymir Mill, shewing Batteries and Plates.

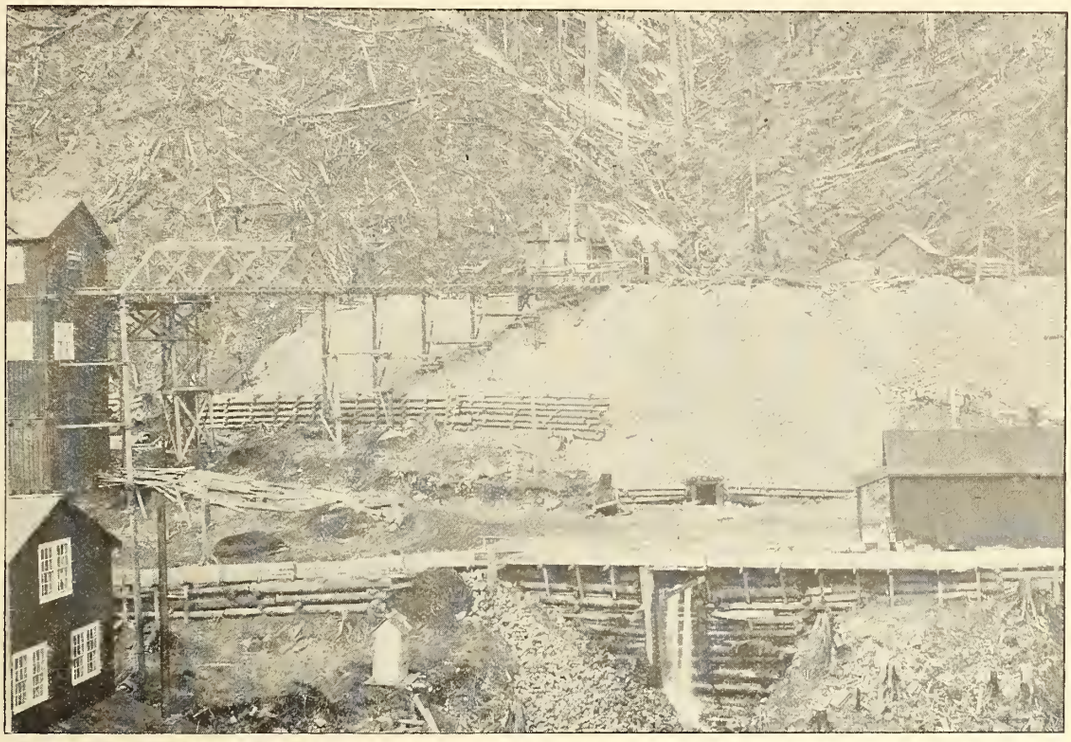


Ymir Mine, B.C.—6-ft. Frue Vanners.

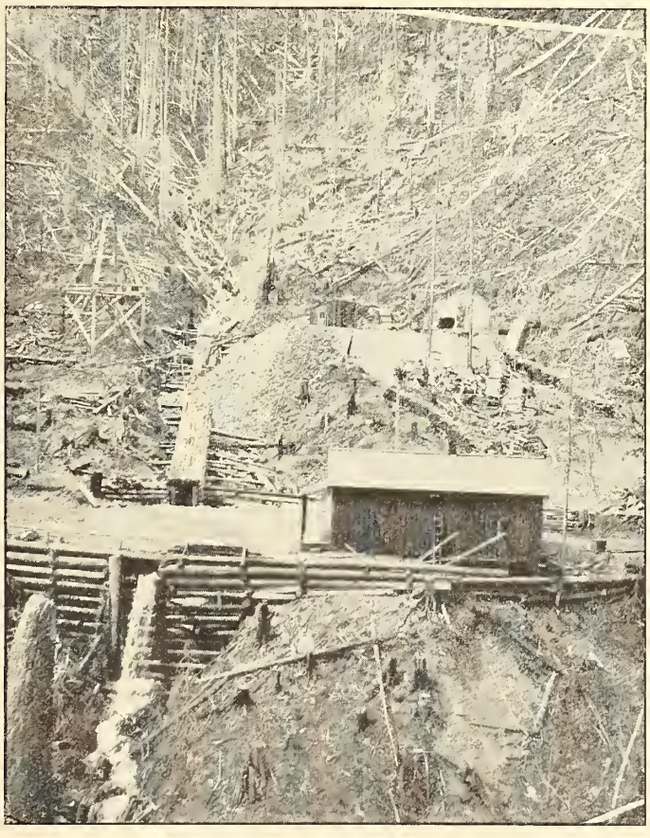
80-STAMP BATTERY AT THE YMIR MINE, B.C.



1—Vanner Room.
2—Gates Crusher at Rock House.
4—Retort Floor.
5—Exterior of Mill
6—Bin Floor.
7—Lower Tram terminal at Rock House, 2,200 ft. from mouth.



Ymir Mine—Adit Level, No. 10 Tunnel.



Ymir Mine—Another view of No. 10 Adit. Photo taken at the beginning of operations.

that such an article going forth unamended as the views of the members in the Transactions of the Canadian Mining Institute, will unquestionably deter capital from considering an investment in British Columbia, espeeially when it has the authority of such a reputation as Mr. Kirby enjoys. It is possible that the production of the detailed figures, which Mr. Kirby supplied to the discussion but which have not yet appeared in print, may afford a means of determining what direct taxation, other than the 2 per cent. mineral tax, is chargeable to the metallic mineral industry; but the Dominion tariff tax, which is common to all Canadian mines, should not be permitted to enter into any statement, or paper, which is supposed to be dealing with *local* or *provincial* burdens.

To remedy an existing evil it is usually better to isolate that evil from any obscuring or attending circumstances, and then attack it unrelentingly; if the ills that British Columbia is at present heir to are of *local* origin, the Dominion should not be brought in. The Canadian Mining Institute is a Dominion association, and the writer is of the opinion that members in other provinces should be given full opportunity for discussing this paper before it is included in the Transactions.

H.

New York, Oct. 20th, 1902.

The Future of the Coal and Coke Supply of British Columbia.

By W. Blakemore, M.E., Fernie, B.C.

The future prosperity of this province depends on an abundant supply of the best quality of fuel at a low price. This controlling factor is determined by two conditions—the general low grade value of our ores, and the fact that the geological formation forbids the existence of coal in proximity to the metalliferous deposits and so involves more or less costly transportation. This governs the conduct of our mining industry absolutely and as I shall be able to show further on is of equal force as applied to other important industries that may be established. The only important consumers of fuel not likely to be handicapped in this respect being the railways, and that because the matter of quality is not so important as in the case of smelting and manufacturing.

Steam Fuel.—As there can be no considerable development without railway transportation it may be well to consider first how our coal deposits will serve existing and prospective railways in British Columbia. The natural surface conditions will probably limit railway construction from east to west to three lines. In the north the Canadian Northern, from the Yellowhead Pass to the Coast. In the centre the Canadian Pacific, from the Kicking Horse Pass to Vancouver, and in the south the Crow's Nest Pass, with some continuation of the same by way of the Similkameen Valley to Vancouver. The difficulties and the cost of building across the mountain ranges of this province are sure to militate against more than these. The natural method of serving the interior will be by means of branch lines running north and south between the mountain ranges. In order that transportation may be as cheap as possible it is necessary that these main lines should pass through or near to large coal deposits of suitable quality for steaming, at any rate this is a present necessity and will remain so until some day, in the possibly not very distant future, when our magnificent water-powers are harnessed to electric locomotion.

The main line of the C.P.R. has hitherto been well served with fuel by the Canmore mines and it is likely that for at least ten years these will continue to furnish all that may be required. The unworked area, however, is not large, and already it is time to look further afield. On the eastern slope of the Rockies, eight miles west of Calgary, we have exposures of coal seams running north and south which are probably continuations of the large bituminous coal field lying to the south. Little or no development work has been done at this point but the exposures are consistent with the theory named and I have little doubt that a season's work would shew up a series of seams of good quality. A line can be gotten as to this by examining the coal at Sheep Creek which, though inferior to that at Canmore, is still of fair quality and such as could well be used in the absence of a higher grade. Recent investigations convince me that the coals found in the Blairmore district and as far south as the entrance to North Kootenay Pass continue northwards parallel to the Rockies far beyond the Yellowhead Pass and, if so, although they are on the Alberta side, they are in an ideal position to furnish steam fuel for the main lines at least half way across the province of British Columbia.

As far as the Canadian Northern is concerned, no portion of this system has yet been constructed, but the route has been surveyed from the Yellowhead Pass to the coast and at three points, at least, good steam coal has been located in large quantities. Two hundred miles east of the Pass, upon the Saskatchewan River, a high-class lignitic coal has been discovered yielding on analysis

Fixed carbon.....	52 per cent.
Volatile combustible matter.....	35 "
Ash	12 "

This is about the same grade as the Lethbridge coal of which more than 1,000 tons a day is mined in the season for steam and domestic purposes, and which is a far superior coal to that used by the Great Northern south of the International line.

At a point 200 miles west of the Yellowhead Pass outcroppings have been met with by the surveyors and at the moment these are being traced. They, no doubt, represent the northern continuation of the cretaceous measures and, if so, the quality will be that of a high grade bituminous coal, and the only question will be as to the extent.

On the Pacific coast, 400 miles north of Vancouver, there are extensive coal seams near the route of the proposed railway. The measures run north and south, and the average of several samples recently taken by a reliable expert shews

Fixed carbon.....	54 per cent.
Volatile combustible matter.....	37 "
Ash.....	14 "

This coal, although high in ash, compares favorably with the fuel recently used on American lines in the west.

Coming to the Crow's Nest line and prospective continuation to the coast, we have the highest grade of steam coal known on this continent in the Crow's Nest Pass and its extensions, and it is not necessary that I should say anything about it except that its only limitation as a railway fuel is one of distance. It will always control the market for this purpose as far west as the Arrow lakes, but recent discoveries farther west tend to shew that as the Columbia and Kootenay extension is built it will open up new coal fields which, by reason of their shorter haul, will secure this trade.

On the north fork of Kettle River outcroppings of high class bituminous coal have been found and are being traced. My own analysis of a sample taken from a 4-ft. seam gives

Fixed carbon.....	62.6 per cent.
Volatile combustible matter	29 6 "
Ash.....	7.8 "

If any considerable quantity of such a fuel as this can be found it will dominate the steam coal trade from the Okanagan lakes east to the Arrow lakes, but it lies nearly 100 miles north of the Boundary district and out of the route of the proposed railway, although it can only be a question of time until a branch is constructed up the Kettle River. Farther west we have two well defined coal fields near

Princeton and Nicola. The former, with Ashnola as its centre, is undoubtedly upon the route of any railway from the Boundary district to the coast, as such a railway must pass up the Similkameen valley at least as far as Princeton, whatever route it may take thence westwards. Here we have a well defined coal basin 8 miles from east to west and 10 or 12 miles from north to south, many seams of lignitic coal outcrop of which a fair average analysis gives

Fixed carbon..... ...	42.0 per cent.
Volatile combustible matter.....	42.7 "
Ash.....	3.0 "

In the absence of a better fuel this would be used by the railway from the Boundary district to the Hope mountains. Only a month ago, however, a 9-ft. seam of good coal was bored through at a depth of 625 feet, which yielded

Fixed carbon.....	54 per cent.
Volatile combustible matter.....	23 "
Ash	8 "

This is full of promise for the future and there are, doubtless, other seams of equal if not superior quality. Thus, the supply of an excellent steam coal for the Columbia and Kootenay is assured.

At Nicola (near which the projected railway will pass if it joins the main line of the C.P.R. at Spence's Bridge) there is an extensive coal field, probably of the same character as the Princeton basin, which would be easily available.

If in connection with these various sources of supply it be borne in mind that we have extensive coal mines in full operation on Vancouver Island, you will see that every part of the province is well furnished with good steam fuel and that the first essential for cheap transportation abounds wherever an important railway is likely to be constructed. I estimate that on the Canadian Northern the maximum haul of steam fuel within the province will not exceed 250 miles; on the main line of the C.P.R., 200; and on the Crow's Nest line, 150. This should give fuel at an actual cost ranging from $2.00 to $3.00 a ton, a figure which would certainly be favorable for the development of the province on the lines of cheap transportation. These figures take no account of other discoveries which will be made in the near future, as there are abundant evidences that there is a continuity in the coal seams of the Rockies, from Mexico to the Yukon; and there are few valleys of British Columbia in which some trace of these does not exist.

Smelting Fuel.—We now have to consider the subject of smelting fuel and probably this will appeal more directly to our members because it "comes home." Without cheap and good smelting fuel the mining industry of British Columbia would come to a standstill. The men who were reviled in 1895 for pronouncing our ores "low grade" have had an ample revenge, and it is now not merely a proven, but an acknowledged fact. Transportation and treatment on Rossland ores have been reduced from $13 to less than $5 a ton, and shipping values from $25 or $30 to $8 or $10. To this result the Crow's Nest coal and coke have contributed not a little, having brought the delivered price of the former down from $12 to $4, and the latter from $17 to $6. During this period we have learnt many things, and some yet remain to be learnt. It must now be admitted that our ores are so low grade that every cent in cost tells and that to develop the industry will require the cheapest fuel that can be obtained. Take for example the great self-fluxing copper district, the Boundary. Is it taking too low an estimate to say that with the exception of a few rich chutes, which may run to $7 or even $8, the vast bodies of ore in that camp will not exceed $4? If this is so and if, as Dr. Ledoux says, fuel represents 65 per cent. of a total smelting cost of $2, then every dollar saved in fuel would mean about 25 cents on the ton of ore treated, a sum which probably represents the difference between profit and loss since it is admitted on all hands, and confirmed by the highest experts, that everything has been done in the way of appliances and economic management to reduce the cost of treatment to the lowest possible figure.

Let us enquire then how the future of smelting in British Columbia is likely to be affected by the fuel question. This practically resolves itself into the enquiry—how can smelting fuel be still further cheapened? There is only one way, by competition. This involves the development of other coal fields and the liberation of some portion of the Goverment coal lands in the Crow's Nest Pass.

First, as to the opening up of other coal fields. At the moment of writing there is, so far as I know, only one place in the interior of British Columbia (outside the Crow's Nest Pass) where coal of a suitable quality for making a first-class smelting coke has been found, viz. on the north fork of the Kettle River. The analysis was given under the heading of "steam fuel." If this deposit should be large enough the quality is all right, and the location being only about 100 miles from the Boundary district, would give it an advantage of at least $1.50 in cost of transportation and would save 40 cents a ton in treating the ore.

The same coal would serve any smelters that might be erected farther west in the event of no coking coal being found in the Similkameen or Nicola valleys, where it is certain there are valuable copper ores and at least three promising camps—Twenty-Mile Creek, Copper Mountain, and Aspen Grove.

For any relief in the cost of fuel in East Kootenay and the eastern camps of West Kootenay, we have to look to the Crow's Nest Pass coal field Leaving for later consideration the Blairmore section of this (because it is in Alberta) we are confined to three sections, viz.: the coal areas owned and operated by the Crow's Nest Pass Coal Co.; those lying to the south beyond the B.C. Southern reserve in the neighborhood of Lodge Pole Creek, Greenhills and Wigwam River; and the 50,000 acres recently selected by the Dominion Government. The former are being developed slowly and having regard to the statement made by the managing director that in addition to the home market the Great Northern company require 10,000 tons a day, it is not likely that this demand will be overcome for many years. In addition, the liability to accidents like the recent deplorable disaster, and to strikes, renders it extremely undesirable that the fuel supply upon which every industry in the Kootenays depends should be in the hands of any one firm, however competent and well-meaning. Then there is the impossibility of getting the lowest possible price from a monopoly. At the moment the charge for coal is $2 and for coke $4 a ton at the ovens As I shall shew, effective competition would reduce these figures to $1.50 and $3 at the ovens, and possibly a little lower. The actual cost of shipping one ton of coal need not exceed $1 and will almost certainly be less after allowing for every item of charge. This would give coke at a cost of $2.25 to $2.50 and leave a margin of 50 cents profit on coal and 75 cents on coke, which is at least double the average rate of profit on coal and coke in the Eastern States or in England over the last twenty years. The present British Columbia consumption of Crow's Nest coal is *1000* tons and of coke *300* tons a day, and a reduction such as the above would mean a saving to the industries of the Kootenays (and mainly to the mining industry) of about $1,000 a day or *$300,000* a year. As the country is growing so rapidly this tonnage would be largely increased in the near future. From what areas could fuel be produced at these figures? Possibly from the sections south and east of the B.C. Southern reserve already referred to. That, however, is at present a matter of speculation, because nothing has been done beyond locating the coals and until develop-

ment work has been carried to a much more advanced stage it cannot be stated with certainty whether the measures are sufficiently continuous and regular to yield a large working area. In any case it will take two years to prove this and will involve the building of a branch railway nearly thirty miles up Lodge Pole Creek.

If, however, the Government would liberate say 5,000 acres of their selection adjoining and on the south side of Morrissey, all the conditions exist to bring about the result I have foreshadowed. At this point the coal seams of the basin are exposed and are most accessible. The measures are regular and dip under uniform strata to the east for several miles until they meet the eastern upthrow which terminates the basin. From exploratory workings conducted here last season I got samples yielding the following analysis :—

No. 1—18-ft. Seam.

Fixed carbon	78.7 per cent.
Volatile matter	17.0 "
Ash	4.3 "

No 2—4-ft. Seam.

Fixed carbon	77 3 per cent.
Volatile matter	18.4 "
Ash	2.8 "

These figures shew that the celebrated coals of the Crow's Nest Pass are at their best on Morrissey Creek as a comparison with the following samples taken from two other points in the Pass indicates :

Fernie—6-ft. Seam.

Fixed carbon	69.14 per cent.
Volatile matter	25.45 "
Ash	3.62 "

Michel—14-ft. Seam.

Fixed carbon	62.40 per cent.
Volatile matter	24 10 "
Ash	12.05 "

This is the only point where coal of equal quality to the best Fernie coal has been discovered and explored sufficiently to enable me to speak with certainty of its extent, and in this view I am confirmed by Mr. J. McEvoy, former Government Geologist. In the interests of the Province, and especially of the mining and smelting industry, no effort should be spared to induce the Government to place this area on the market. There is no legal impediment or obligation in the way and I have little doubt that an unanimous request would attain a result so important to the future of the Kootenays in particular.

This brings me to consider another source from which relief may come in any case through the ordinary healthy channels of competition. I refer to the Blairmore coal field. Having done most of the prospecting work that has been done here this year I am able to give you the latest information. Here we have what I believe to be the same series of coal measures as are found in the Pass, only instead of having been uplifted in the form of an elongated basin or trough they are uplifted and fractured in longitudinal lines and exposed in ridges running north and south, or nearly so, parallel with the Rockies. The result is much folding and duplication, but at the same time many more exposures of the same seam, and increased facility of access.

These conditions have been proved in extensive properties owned and controlled by Mr. Leslie Hill, Mr. T. G. Procter, Messrs. McVittie and Leitch, Messrs. Davenport and Paine, and others. The coal seams which correspond in thickness and occurrence with those of Fernie and Morrissey have been traced from the entrance to the north Kootenay Pass where Mr. J. J. Hill has secured 10,000 acres to a point 20 miles north of Blairmore. Messrs. Frank and Geho have developed a successful mine on the east side of Turtle Mountain which has already attained an output of 800 tons a day, the coal being excellent for steam purposes. My own object in taking up certain bonds in this important coal field was to determine its character for coking purposes and to ascertain how it compared with Fernie coal. The result you can best judge from the following analyses taken by me from comparatively shallow workings, the ash is certain to be less at greater depth :

	Fixed Car.	Volatile.	Ash.
No. 1	63.4	29.1	7.4
No. 2	64.5	26.5	9.0
No. 3	67.7	25.5	6 8
No. 4 (20 miles north of Blairmore)	58.9	28.5	11.8
No. 5	60.3	31.3	7.4

Samples Nos. 1, 2 and 3 are all first-class coking coals, Nos. 4 and 5 good steam.

This coal field is so near to the province of B. C. that it will seek its natural market there for coal and coke, especially the latter, and the mode of occurrence of the seams being more favorable for cheap working than in the Pass, there is no reason why the cost of production may not offset the extra transportation, a matter of 30 to 50 miles. At any rate I am convinced that in less than two years from date we shall see coal and coke of satisfactory quality being produced in this district at the figures I have already named to the enormous benefit of the various industries of Southern British Columbia.

Development of Coarse Concentration in the Slocan District, B.C.

By Samuel S. Fowler, S.B., E.M., Nelson B.C.

The silver-lead mining industry of the Slocan has now been alive approximately ten years, a time sufficient for it to have taken on a definite form and to have become of definite importance. This form, although, we think, not yet a perfected one, quite naturally has been attained only by passing through many struggles with nature and with man, and yet these both have done much toward its growth and its perfection. To-day it is just about holding its own in an equal contest; but it needs help to win and to survive.

It is not our purpose to discuss the form or extent of assistance necessary, nor yet to enter into many purely technical details of concentration as now followed : it is rather to consider what has been done toward working the deposits economically and thus doing all that is possible locally to bring about the stability of the industry.

Without considering certain evidences of an earlier knowledge of one or two deposits of ore, the "Slocan" first became known in the late Autumn of 1891. The grade of the ores in silver was found to be so high that, although the price then was considered low (above 90 cents per oz.), the discoveries caused much excitement and the district was the scene of great activity during the year 1892. The activity was well justified, too, for during the year several shipments of ore were made, and these proved that, generally, wherever galena was found, it was of sufficiently good grade in silver to be marketed profitably, containing as it did, say, 150 ounces or more of silver per ton, and 50 per cent. lead.

As is often the case, the region was a wilderness and "transportation" was far away. Kaslo, on the west shore of Kootenay Lake, was the first town to be created because of the discoveries, and it was not long before the energy of its citizens took form in the building of a wagon road up Kaslo Creek, 20 miles to Bear Lake. Many trails also were reaching out to many claims, and shipments were made on a sufficient scale during 1892 to afford a good knowledge of the resources of the region.

But, discouragement was soon to come, as it did in 1893, in the

fall of silver. This, however, was only a shock which served to quicken the senses of the workers in this still new field, and with energy and a realization that expensive mining plant was not an essential, the claim owners kept on with such success in their efforts, that the Canadian Pacific Railway Company had a branch line well under construction during the year for the purpose of entering the field. This was completed in the autumn of 1894 as far as Three Forks, 36.6 miles from Nakusp on the Arrow Lakes. The year 1894 also saw the formation of a company to build a narrow gauge line from Kaslo to Sandon, 28 miles, and this railway was built to the latter point in 1895. Moreover, as Sandon was several miles nearer to the centre of probable production than Three Forks, the Canadian Pacific line was extended from the latter point to Sandon, thus affording competitive transport facilities, the effect of which has been felt favorably ever since.

It is difficult to get accurate statistics of what the output of silver-lead has been up to the end of 1894, and no comparison can therefore well be made with the output of later years; but the effect of the advent of railways can be imagined. Suffice it to say that not only did the volume of shipments increase, but the cost of operation decreased, while development work received a decided impetus.

It should be remarked, here, that what had been accomplished at the time of the completion of the railways, and even in large measure since then, had been without any extraordinary effort, and without the aid of any large amount of outside capital; indeed, many of the shipping properties had paid "from the grass-roots". It was, nevertheless, beginning to be felt that sooner or later an important part of the output must be won by mechanical means, the present importance of which will be shown hereinafter.

The geological and physical features of the Slocan ore deposits are not germane to our subject, but in passing it may be well to give a brief statement of these. For our purposes we would describe the Slocan District as a ruggedly mountainous area lying west and north of Kootenay Lake and its west arm, east of Slocan Lake, and south of a line extended east from the north end of the latter. In the northern part of this area we find about 100 square miles of the "Slocan *slates*,"* from which by far the greater part of the silver-lead output has been derived. The ore bodies usually cut across the slates, are from a few inches to many feet in width, are probably genetically related to a series of porphyry (felsite) and other dykes, and, beside the usually occuring gangue minerals, which are chiefly spathic iron and quartz, in the case of the larger deposits contain many inclusions of the country slate.†

South of the slates we find a large area of coarse *granite*, in which are many veins of value. Those which contain any notable amount of lead and zinc minerals are quite narrow when compared to the deposits found in the slates; but because of the hardness of the granite, the fissures are often much more sharply limited as to their walls, and fewer large inclusions of the country rock are found. The ores are harder and tougher, contain a greater proportion of quartz and spathic iron to valuable mineral, a greater variety of other gangue minerals, and important amounts of the richer silver-bearing minerals, finely disseminated. As in the slates, an important part, and indeed frequently the chief part of the values, is highly concentrated, and is extracted and shipped, with little sorting, as "clean ore".

East of the slates and granite, we find along the west shore of Kootenay Lake, a narrow fringe of very old schists and slates, which, in the vicinity of the town of Ainsworth, carry valuable deposits of good size and apparent permanence. But the ores are of low grade in silver (excepting some which lie near the granite area), and although considerable shipments have been made, they cannot under present conditions yield much, if any, profit.

I have stated above that a large part of the Slocan output has been derived from those portions of the deposits which contained the ore in a concentrated or "clean" state. It will be understood that a vast amount of material has been broken down in this process, which could not be formerly profitably disposed of. This may be somewhat enriched by such small fragments of the clean ore as escaped the miners' vigilence, and was used for filling stopes or placed on dumps, until such times as it could be treated by mechanical means. Such second class ores, together with the parts of the deposits which contained no clean ore, accumulated to an enormous amount, and of late years have formed the basis of operations very important to the district.

The experience of most of the mines has shown that the process of hand-sorting, even of the so-called solid ore, was at best a very expensive one, and very inefficient. The tendency has thus been toward the adoption of means to cut down the cost and improve the quality of the work, whilst at the same time winning such of the values as would otherwise lie dormant. Latterly, therefore, the proportion of hand-sorted ore to total shipments has declined noticeably.

CHARACTER OF PRODUCT.

The material shipped from the region described, is (*a*) silicious oxidized ore from near the surface of the deposits which are in slate. This product was formerly of important quantity, was often high grade in silver, and carried about 20 per cent. to 30 per cent. of lead; but it is no longer of much, if any, importance, the superficial portion of the veins having in most cases been worked out. (*b*) *Galena.*—This forms now the bulk of product, whether as coarse, hand-sorted ore, or as concentrate. The shipments are still high grade in silver, say, 80 to 100 ozs. per ton, and probably average about 40 per cent. lead. It is impossible to give any average analysis of this material as a whole, but besides the lead, about 12 per cent. of zinc may be said to be present, and of the balance the chief constituents are quartz and spathic iron, which, by reason of the imperfections of all processes, cannot well be eliminated efficiently, *i.e.*, without the loss of too much value or at too great expense. (*c*) *Dry Ores.*—Chiefly silicious, silver bearing material, very low in lead. This class is now derived principally from the granite area, and up to the present, is not amenable to efficient concentration. It is therefore shipped direct to smelters, who employ it as a flux, and as a diluent of the heavy lead ores in the furnace "charges." (*d*) *Silver-bearing Zinc.*—This is found of high grade in several properties, and some has been shipped either as hand-sorted or as a middle product from some mills, either by itself to European smelters, who allowed payment for the zinc content, or mixed with the galena concentrate after elimination of gangue minerals. The Slocan is affording a gradually increasing amount of this rich zinc, and a satisfactory solution of the problem of realizing on all the values is at present one of our greatest troubles. Not discouraged, however, several of those in charge of plants appear to be approaching a solution, of which it is yet too early to speak.

PRODUCTION.

It is extremely difficult, if not impossible, at this late day, to get accurate figures of production for the first three years of Slocan output. Those given in the "official reports" are essentially Customs returns, and the metal contents of exports have always been only approximately stated. The figures of output since 1894, however, thanks to the careful work of the Provincial Mineralogists of British Columbia, are dependable.

If we refer to the reports of the Minister of Mines of British Columbia for 1894 and subsequent years, we find the basis of the following table of silver lead production in the "Ainsworth" and Slocan mining divisions, which embrace the area which we call Slocan.

* So named by the Geological Survey of Canada: See Mr. McConnell's Report for the year 1895.

† This latter characteristic might better, in some cases, be expressed as a penetration of the fractured slates by the ores.

Year	Ozs Silver.	Tons Lead (2000 lbs)	1 Unit of Lead (20 lbs) contains.... ozs. Silver.
1892-94*	1,050,539	4,783	2.20
1895	1,400,070	8,238	1.70
1896	2,328,355	10,686	2.18
1897	4 165,865	17,126	2.43
1898	3,235,795	14,520	2.23
1899	2,159,190	10,125	2.13
1900	2,473,343	11,466	2.16
1901	2,601,172	9,407	2.76
Total	19,414,329	86,351	Av. 2.25

These figures are of much interest to those immediately concerned, and exhibit the effects of certain causes, but for us the main interest centers in the column of ratios of lead to silver. When we explain that in 1895 the ratio is low because the old Bluebell mine was producing a very large amount of lead of low silver tenure, and that in 1901 there was a heavy output of dry silver ores, with concurrent small lead production, the ratio was high, there is a remarkable uniformity in grade of output. A second point of interest is revealed in the average ratio of two and one quarter ounces of silver to each unit of lead. This implies much richer ore than is produced on a large scale in any other district of the Northwest, and the richness is still more evident when we state that the ratio in East Kootenay is only one-half of one ounce per unit, and in the Coeur D'Alene district of Idaho, it is somewhat less yet. It should be remembered, too, that whatever ore was produced near the town of Ainsworth tended to reduce the average ratio, which is there about one to one, and the comparisons above made are, therefore, all the more remarkable.

The figures given above tend to show not only a very good reason for the rapid advance of the Slocan, but they indicate the important differences between successful concentration in Slocan and in East Kootenay or the Coeur D'Alene, when commercial results are considered. Putting the difference tersely, and assuming that all the silver is contained in lead, a loss of one per cent. of lead in tailings, means in the Slocan four and a half times as much as it does in the other places. The layman will quickly point the moral—"Save your lead"—but just where to stop is the problem for each manager to solve in his own case, and no line or limit can be arbitrarily set, nor can we say that it is not better to save only 70 per cent. in one case than 85 per cent in another. Millmen throughout the Northwest, confronted by conditions of very high wages and expensive supplies, may and do often find it best to sacrifice high efficiencies to the better commercial results attained by rapid operation and large tonnages. In a general way this has been proved desirable in Coeur D'Alene, but in Slocan it is not so much so. Our observations lead us to the statement that in many instances the relations of the commercial and technical factors of concentration have not been sufficiently studied before construction has been started. Indeed, it is within only the last two or three years that there has been any considerable departure from the details of mill design, which have been so long regarded as incapable of improvement. The earlier designs followed the Coeur D'Alene practice very closely, with rapid running and low costs as the chief aim. Latterly the modifications have been in the direction of possibly greater first cost, and increased efficiency, without increasrng the operating cost, especially in the fine end of the mills.

Coming now to an enumeration of the mills which have been built, we believe that even those who are familiar with the Slocan will be surprised at their number. The mills and years of construction are as follows:—

1—Alamo	1894
2—Washington	1896
3—Slocan Star	1896
4—Noble Five	1897
5—Whitewater	1898
6—Montezuma	1898
7—Comstock	1898
8—Jackson	1899
9—Ruth	1899
10—Wakefield	1900
11—Ivanhoe	1900
12—Enterprise	1901
13—Payne	1902
14—Rambler Cariboo.	1902
15—Pilot Bay	1893 (?)
16—No One	(?)
17—Woodbury	(?)
18—Highlander	1899
19—Highland	1900

Of these the last four are in the vicinity of Ainsworth, and have treated the low grade ores of that camp. The Pilot Bay mill, in 1895, treated the ores of Bluebell mine. The Washington mill was dismantled during 1901, and the plant rebuilt at the Rambler-Cariboo.

The combined capacity of these plants is probably about 2100 tons daily, and their erection has probably involved an outlay of well over $500,000.00. Of the total number only five happen to be in operation at present, while of the remaining thirteen, six were erected, in our opinion, without sufficient justification as to tonnage in sight. The others are not in operation for various reasons which it is hardly necessary to discuss here.

Among so many plants one easily discovers differences of design and operating scheme, and, as might be expected, the technical results obtained probably vary within wide limits. Of the more prominent mills, however, no less than seven were designed and erected under the supervision of one man, who, in outward appearance of his structures at least, has quite naturally followed one general plan, eminently adapted to local conditions; and we may also say that no matter how much we may differ from this designer in detail of scheme, he has been very successful in producing mills which are operated at low costs for labor.

By way of brief description of the process, we would say that the ores are delivered to mill storage bin. From this they pass over only a small Grizzley to Blake crusher, set so that the maximum size of product will be about one and a half inch. With or without an intervening bin, the ore passes through a belt-driven cam feeder to roughing rolls, belt driven, usually not less than 30 in. diameter, nor more than 12 in. faces, running at about 110 revolutions. These rolls discharge to an elevator and thence to trommels, whose screen sizes vary from 21 mm. to 2 mm. Sizes over 2 mm. pass to Hartz jigs, and those under 2 mm. to hydraulic separators, from which, sizes above 1 mm. go to fine Hartz jigs, and those below 1 mm. through spitzkasten to some form of vanner, or other table machine, or formerly to revolving single or double-decked buddles. Middling products from coarse jigs are re-crushed by rolls usually duplicates of the roughing rolls, while middlings from finest jigs and the tables are commonly re-crushed in Huntington mills. The concentrate is conveyed by water through launders to a series of bins where it drains, and is put into jute sacks for shipment to the smelter.

The general course of the ore and products through the mill will thus be seen not to differ in any material way from that of other regions where coarse concentration is practised. When we examine into details and results, however, we are forced to the conclusion that better work can be done, and we therefore venture to offer the following comments on the process as now carried on to any who contemplate the erection of concentration plants in the Slocan.

We have remarked above on the the high ratio of silver to lead in these ores. This ratio is high not only because the galena, when perfectly clean, is usually high grade in silver, but because of the admixture of gray copper and other rich silver-bearing minerals. These, as well as the galena, are not only soft, but very friable, and what with their tendency to breaking very finely in the crushers and rolls, and the results of attrition on the beds of the jigs, a surprising quantity of rich material soon finds its way out of the mill by illegitimate means, and the

* The figures for these three years are for the *entire* British Columbia output, but as this was essentially all from the region we call Slocan, the figures may be regarded, for our purposes, as sufficiently accurate.

vehicle largely responsible is the final overflow of water from concentrate bins and from the spitzkasten, whose settlings feed the vanners or tables. Almost all mills attempt to remedy this evil by means of shallow settling vats placed below the concentrate bins; and in a measure these are useful. Our experience shows, however, that not only is the overflow still valuable, though less in quantity, but that the material saved, on account of the extreme fineness, holds about three times as much water as the normal concentrate, is lower grade in lead and silver and higher in zinc. The same remark as to quality would apply in greater degree to the overflow from spitzkasten. As to the latter, we may say that in order to reduce losses in this direction, we have returned this overflow in one instance, and concurrently reduced the volume of clean wash water on various machines, with some degree of success; but at best the scheme is only a make-shift, and I believe that we are doctoring this difficulty at the wrong end. We should prevent the evil rather than remedy it, by providing a short sorting belt above the coarse crusher. This need not be over, say, six feet long, would cost little and could be handled by the crusher tender, whose functions now are chiefly those of a watchman. The sorting belt is practically unknown to the Slocan mill, and without reverting in more than slight degree to the labor-devouring practice of Europe, I know from experience that in some instances a limited introduction would be a paying one. As indicating the result which may be expected, where the mill feed contains an appreciable quantity of galena in pieces of the size of one's fist, or larger, I may cite an instance at one of the mills of which I am in general charge. In the summer of 1900, our crushermen, under instructions, picked out from the ore stream passing over the grizzley such pieces of coarse galena as they could conveniently, and without any special care. The feed was not sprinkled, and much of the galena which was coarse enough to have been easily sorted on a belt, probably escaped into the crusher. During a period of about four months, 120 tons of galena were thus sorted, equivalent to about 8 per cent. of the total concentrate made in the same period. Comparative average assays of the two products are given; viz:—

	Silver.	Lead.	Zinc.	Ratio.
Sorted Galena.....	101.7 ozs.	40.2	15.4	2.53
Concentrate.....	73.0 "	30.0	21.0	2.43

For this galena we received from the smelter about $670.00, and had it been sent through the mill in the usual way, it is safe to state that fully 10 per cent. would have been lost.

It cost us nothing to save that $670.00. How much more could have been saved by the aid of proper appliances I do not know; but there is no doubt about the accuracy of the data, nor, I think, of what they indicate.

Another notable feature of our mills is the absence of any general attempt at close sizing before jigging. In this respect we follow the common tendency of the Northwest, and more particularly the Coeur D'Alene, unless the practice of that region has changed since I was more familiar with it than I am at present. In many places the low grade of ore demands, or its simplicity permits, good results to be obtained without that close sizing which our German friends formerly thought essential, but about which American authorities have had considerable differences of opinion. There is no doubt in my mind, however, that Slocan mills cannot do efficient separation without close sizing. An extreme instance is often more likely to impress one than a normal case of difficulty. I therefore give the following:—

At the Whitewater mill the feed consists essentially of slate, "talc", zinc blende, copper and iron pyrites, gray copper, quartz, calcite, spathic iron and galena. At our Enterprise mill the slate is replaced by granite, and we find, beside the Whitewater minerals named, important quantities of complex carbonates of iron, lime manganese and magnesia, some undetermined manganese zinc iron compounds, probably silicates and oxides, to say nothing of the rich silver minerals and native silver.

Now were our gangue minerals all simple and of low specific gravity, we would consider our way easy, and have little difficulty in doing respectable work with a simple screening system. The presence of all of the minerals above named is of course troublesome, but these obstacles to success are not insuperable. When we begin a proper study of conditions at Whitewater, we are stunned by the discovery that "galena" is not galena at all, for it is a mixture, I might say a concrete of comminuted slate, galena and zinc, with accluded particles of several of the gangue minerals named, the whole having a gravity of 4.75 to 5.25. This is so typical of the Whitewater mine that shipments of large quantities of well hand-sorted product, before our mill was built, shewed an average content of about 35 per cent. of lead and 16 per cent. of zinc, equivalent to, say, 40 per cent. galena, 24 per cent. zinc blende, and the balance, or 36 per cent. virtually barren gangue. Galena of a gravity of 5.0, and barren pyrites of a gravity of 5.0, mixed with barren blende of a levity of 4.5, form a sort of ore dressing joke whose density is so great that one cannot laugh, with any enjoyment, and hold one's position at the same time. It appears to me that the only satisfactory way of solving such difficulties as are implied above, is through a more extended screen system than we employ. I am not prepared to say that we should go to the extreme limit of some German practice, but I do think that our mills should be designed with what one may call a greater limit of elasticity, one which will permit rapid and convenient alteration or extension of the screening department. The day has gone by when the man who wants a mill should go to a drawer and pull out a stock plan labelled with a specific tonnage capacity. Certain essential features of mill construction must always remain the same, but each new case of installation must have its details considered by themselves. Granting conditions of well sized feed, and a uniform quantity, I think the Slocan jig practice very efficient. The feed above 3 mm. in size usually forms nearly 80 per cent of our tonnage although more nearly 30 per cent of our values reach the fine jigs and tables. Indeed, in one instance the jig tailings were all eventually crushed fine enough to reach a row of seven Wilfley tables, I believe with results which were good. Here, of course, a smaller percentage of product was made on jigs. The usual run of jig tailings seldom contains more than one-third as much silver as the fine end tailings do, and often it happens that the work of the coarsest jigs is practically perfect. This is due in large measure, in some cases at least to the inclusion of coarse slate, quartz and calcite in the ore, all of these being generally barren of silver.

The fine end of our mills certainly affords room for very great improvement. In the mills which were built from 1896 to 1899, the most common machine used on the finer feed were double-decked revolving buddles, and although some are still in evidence, the majority have been replaced by other types. There are several reasons for this change, especially where the very finest pulp was being treated: 1st. the buddle was handicapped by imperfect classification of feed; 2nd. the wooden surface seemed to accumulate some vegetable slime which permitted the metallic minerals to escape too soon, and 3rd. in cases where volume of water was a consideration, it was found very wasteful. The buddle advocate has accused us of ignorance as to how to work that machine. This may be just, but the fact remains that, in one mill, an extended comparison, on feed as nearly indentical as possible, resulted in a saving of 300 lbs. more of a much better product, in 24 hours, with about one-tenth of the volume of wash used, the table used occupying only one half the floor space of the buddle.

The unsatisfactory work of classifiers, of course, operates against any concentrating machine, and we still have troubles to overcome in the fine end, which no number of machines of existing types will bring about. Some one will always get a portion of what the preceding one failed to secure, so we are compelled to set a limit to plant which is governed by questions of dollars and cents. Slocan seems to have

discovered that, on account of the excessive cost of machinery and installation, it does not pay to try to save more in the fine end than can at present be recovered by one passage of pulp finer than half a millimetere over well known machines of proved merit. Attention is, however, being paid to slime treatment, and some very careful experimental work conducted, which is so encouraging as to cause us to say that the close of this year will witness our probable ability to make an efficiency of well over 85 per cent. in silver a paying one.

This brings us naturally to what the present efficiencies are, and the subject is a delicate one. Aside from the fact that there are many millmen who, through false reasoning, would not confess to high losses, I believe there are more who do not know their actual losses, because of the general absence of automatic sampling devices for the tailings, and the too frequent use of the fire assay instead of the wet, in determination of lead. There is too much of a tendency among mill men to assume that, because they cannot see galena, for instance in tailings, the best possible work is being done. This assumption is, I think, a commercially justifiable one in many cases, but it affords no good reason for not knowing instead of guessing at losses. Personally I consider an accurate sampling of tails, and wet lead tests, of the greatest importance, in the Slocan, and especially where much slate is present in the feed.

To illustrate the importance of the wet assay for lead, I may say that a series of important trials of pulps show a loss by fire method of from 70 per cent. to 100 per cent. of the actual lead present, when the wet test shows, say, under 2 per cent. in the sample, and in a recent trial the wet test showed 1.36 per cent. and 1.42 per cent. the fire assay none. The feed from which these tailings were derived contained 4.7 per cent. and 5.2 per cent. lead respectively, and the fire assay therefore perfection in the mill work, while the wet test gave efficiencies of 71 per cent. and 73 per cent. only. These results would be slightly improved, of course, if the tailings losses were worked out per ton of feed, but the figures illustrate our point; viz., not to deceive ourselves through wrong method of determining our efficiency. I do not pretend to know what degree of perfection is attained by others, but our own experience shows an actual recovery of 74 per cent. of silver and 82 per cent. of lead, from a feed of 10 ounces silver and 40 per cent. lead. Those who are not familiar with the shortcomings of existing types of concentrating machinery in use on a large scale, and those who do not care to know how poor a quality of work may be done, will regard these efficiencies as wickedly low. I am confident, however, that thorough investigation would show them to be excellent under the circumstances.

COSTS.

The operating costs in Slocan mills are, as everywhere, very much dependent on the tonnage treated, but the cheapness of our power is an important factor. The ruggedness of the mountains permits convenient installation of small water power plants, working commonly under heads of three or four hundred feet, and while in some instances sufficient, if any, gaugings of flow have not been made before location of plant was decided upon, to determine the dependable volumes, heavy snow-fall and even the presence of the glaciers at the head waters, insure sufficient wather throughout the year on lateral creeks, at points very close to many of the mines. It is not necessary to dilate on this phase of the facts; suffice it to say that none of the mills except two on Kootenay lake have any steam power plants. Most of the plants are designed with a view to saving of labor, and are compactly arranged. Their efficiency in this respect may be seen from the table of costs below, being results attained in operating one of the more prominent mills:—

Period, 557 days of 22 hours.
Tons of feed milled, 100,824 (including 7 per cent. moisture).
Tons milled per day, 181.

Costs.	Per Ton.	Per Day.
Crushermen	$.0364	$6.59
Foremen, jigmen and tablemen	.1613	29.19
Miscellaneous labor	.0223	4.04
Operating supplies	.0248	4.49
Maintenance and repairs of all plant; labor and material	.0958	7.34
	$.3406	$61.65

These costs do not provide for depreciation or insurance, the amount of which is of course largely a matter of judgement and conditions. The cost of maintaining the flume was 15/100 of one cent per ton, and thus practically a negligible account. It will be noted that the above figures make no provision for handling and disposal of product. The cost of this in the table would have added $.0557 per ton of ore, but as the figure depends upon the richness of the ore, these costs of sacks and sacking are placed by us under another head, or are stated as so much per ton of product, (in this instance 56 cents). In this plant two hours are allowed every day for the common light repairs, and the practice has proved a good one in preventing many annoying shut-downs. We believe that with the tonnage treated, these costs would be difficult to lower, and they are given as an indication of what has been done on a large scale, without fear of serious adverse criticism.

Copper-Nickel Mining in Ontario.

Mr. T. W. Gibson, Director of the Bureau of Mines, has an interesting review of the nickel and copper mining industries of Ontario from which we take pleasure in reproducing the following abstract:—

"Nickel mining occupies the chief place in the list of mineral industries for 1901, the output of nickel exceeding in value that of any other single product, though closely followed by pig iron. The production for the year amounted to 8,882,000 pounds, or 4,441 tons, valued in the matte at $1,859,970, an increase in quantity of 25 per cent., and in value of 145 per cent., as compared with 1900, when the yield was 3,540 tons valued at $756,626. The output in 1901 reached the highest point yet recorded.

It will be observed that the advance in value in comparison with the previous year was much greater in proportion than the advance in production. The reason for this will be made plain by the following explanation. About the middle of the year 1901 the Ontario Smelting Works erected by Col. R. M. Thompson at Copper Cliff for the purpose of re-treating the low-grade mattes made in the furnaces of the Canadian Copper Company, began operations, the effect of the re-treatment being to raise the metallic contents of the matte from say 30 up to about 70 per cent. Additional labor and expense having thus been expended upon the mattes, and the metals contained in them having been brought so much nearer the point of actual refinement and separation, it follows that the contents were worth more per pound in the high-grade than in the low-grade condition. It has been the practice of the Bureau to compute the value of the Sudbury nickel-copper mattes at their selling price at the place of production, and not at the price of the refined metals, consequently the relative as well as the absolute value of the nickel and copper contained in the mattes produced in 1901, was considerably higher than in 1900, when only the low-grade product was made. The average price at which the nickel contents of matte were appraised in 1900 was 10.7 cents per pound, while in 1901 it was 20.9 cents. Only about one-half the product of the Canadian Copper Company's smelters was treated at the Ontario Smelting Works last year, consequently the total increase in value of the nickel is not so great as it would have been had the whole of the product been re-handled.

It is not uncommon for the metals contained in raw or partly treated ores to be valued for statistical purposes at their full selling price in a refined condition. This method is adopted, for instance, by the Geological Survey of Canada, and by the mining departments of one or more of the Provinces, and were it applied to the nickel and copper of the mattes produced in the Sudbury region, the values would have been given as $4,440,000 and $1,450,000, instead of $1,859,970 and $589,080 respectively. The apparent value of the mineral output of the Province would have been increased by upwards of $3,440,000, but the gain would have been in seeming only, not in reality. So long as the product of the mines is exported in an unfinished condition, so long ought it in strictness to be set down for what it really is worth, namely the price at which it would be sold at the place of production. There are advantages, too, in adhering to an established basis of valuation, a departure from which would make it difficult to compare the figures of one year with those of another.

The following table gives the principal features of the nickel-copper industry for the last five years, and clearly shows the substantial growth made during that time:

PROGRESS OF NICKEL-COPPER MINING, 1897-1901.

Schedule.	1897.	1898.	1899.	1900.	1900.
Ore raised.....tons	93,155	123,920	203,118	216,695	326,945
Ore smelted .... "	96,093	121,924	171,230	211,960	270,380
Ordinary matte duced..... "	13,706	21,101	19,109	23,336	29,588
High-grade matte produced..... "	328	.....	106	112	15,546
Nickel contents. "	1,999	2,783¾	2,872	3,540	4,441
Copper contents. "	2,750	4,186¾	2,834	3,364	4,197
Value of nickel.. $	359,651	514 220	526,104	756,626	1,859,970
Value of copper. "	200,067	268,080	176,236	319,681	589,080
Wages paid..... "	253,226	315,501	443,879	728,946	1,045,889
Men employed..No.	535	637	839	1,444	2,284

During the ten years beginning with 1892 and ending with 1901, according to the returns made to the Bureau of Mines by the producing companies, there have been raised from the nickel-copper and copper mines of Ontario a total of 1,306,722 tons of ore. Of this quantity 1,245,422 tons have been smelted into matte containing 52,411,000 pounds or 26,606 tons of metallic nickel, and 56,140,500 pounds or 28,070 tons of metallic copper. Computed at the selling prices of the refined metals in the New York market, the nickel was worth $20,500,000, and the copper $7,000,000, a total of $27,500,000, or an average annual output of $2,750,000. The production has been on a growing ratio, and the yield and value during the latter part of the 10-year period were much greater than in the earlier part. For instance, in 1892 there were 72,349 tons of ore raised, and matte containing 2,082 tons nickel and 1,936 tons copper produced; while in 1901 the ore raised amounted to 326,945 tons, and the matte turned out by the furnaces contained 4,441 tons nickel and 4,537 tons copper. In 1892 the mines employed 690 men and paid out $339,821 in wages. In 1901 the number of workmen was 2,284 and the amount paid out in wages $1,045,889. The matte produced in 1892 was valued at $823,037, while in 1901 the product was worth $2,449,050. As stated, the foregoing figures include the copper produced by the non nickeliferous copper mines of the north shores of Lake Huron and elsewhere in the Province, but so far the output from this source has not been large. The prospects are, however, for a considerable increase from the purely copper mines at a not distant date.

The price of nickel remained steady throughout the year, being quoted at about 50 cents per pound in New York. The producing companies in the Sudbury district have been prosecuting their operations vigorously. These comprise the Canadian Copper Company at Copper Cliff, the Mond Nickel Company at Victoria Mines, and the Lake Superior Power Company. Matte is not yet being turned out by the last-named company, but the Gertrude and Elsie mines have been opened up and are yielding considerable ore, part of which is being roasted on the former property, where smelting works are also being erected. Picked ore from the Gertrude containing little or no copper is taken to the company's reduction works at Sault Ste. Marie for treatment. At Victoria Mines the Mond Nickel Company's plant began turning out matte during the year by the Bessemer process. The product is a high grade article carrying about 80 per cent. metallic contents in equal proportions of nickel and copper, the iron in the ore being almost entirely eliminated. The matte is sent to Great Britain, where it is refined near Swansea, Wales, by Dr. Mond's own process.* The smelting establishment at Victoria Mines is well-equipped and modern in its appointments, the offices and other buildings connected with the business are tasteful and substantial. Less than two years ago the site of the village was a swamp, but it now shows a number of comfortable houses with electric lights and other adjuncts of civilization.

The bulk of the nickel and copper is produced by the Canadian Copper Company, whose mines and works have now been operated for a period of about fifteen years. A feature of this company's business in 1901, was the opening of an immense deposit of nickeliferous pyrrhotite and copper pyrites on lot 10 in the first concession of the township of Snider, called the Creighton mine. This remained one of the company's undeveloped properties until the construction of the Manitoulin and North Shore Railway from Sudbury rendered it accessible. The body of ore, which is exposed on the surface in very considerable dimensions, was sunk upon, and so far the work has been carried on as an open cut, shipments to the smelters at Copper Cliff averaging perhaps 500 or 600 tons a day. The ore is said to run higher in both nickel and copper than the average of the district.

A distinct advance in the treatment of the company's ores was made during the year by the commencement of operations at the Ontario Smelting Works, a plant established at Copper Cliff by Col. R. M. Thompson, president of the Orford Copper Company, with the object of re treating the low-grade mattes produced at the Copper Cliff smelters and raising their metallic contents from 30 to about 70 per cent. This is effected by crushing, grinding, calcining and re-smelting the matte, thus getting rid of a great deal of the rock-matter, iron and sulphur, and producing an article so much nearer the point of actual refinement and separation of the metals.

THE NICKEL COMBINATION.

Since the beginning of the present year (1902) there have been many rumors of an impending sale of the Canadian Copper Company's mines to other American capitalists, and a recent publication† contains what appears to be an authentic account of the consummation of the transaction. What appears to have taken place is a consolidation of the Canadian Copper Company and Orford Copper Company, always hitherto closely allied, and the transfer of the properties and stock of these companies and of some other less highly developed Ontario concerns, together with certain nickel interests in New Caledonia and refining works in the United States, to a new company called the International Nickel Company, formed under the laws of the State of New Jersey with $12,000,000 common and $12,000,000 preferred

* Dr. Mond's works have a capacity of about 1,000 tons refined nickel per annum, but provision is made for increasing the output. The copper is recovered as sulphate of copper. Refining operations on a commercial scale began about 1st April, 1902.

† Engineering and Mining Jouraal, New York, April 5, 1902, p. 474.

stock, and $10,000,000 worth of bonds. Of this amount, $9,000,000 common and $9,000,000 preferred stock is to be issued to acquire the properties taken over. The Anglo American Iron Company, which owns iron lands, mostly undeveloped, in the County of Hastings, and the Vermilion Mining Company, whose nickel property in the Sudbury district was looked upon as valuable in the early days of mining there but on which nothing has been done for many years, are non active Ontario concerns acquired by the new corporation. The companies holding nickel lands in New Caledonia are the Nickel Corporation, Limited, and the Société Minière Calédonienne, neither of which, so far as is known, has yet contributed much to the supply of nickel. The refining works owned by Mr. Joseph Wharton in Camden, N.J., are also taken over.

Actively interested in bringing the transaction to a close are said to have been Mr. Chas. M. Schwab, of the United States Steel Corporation, Col. R. M. Thompson of the Orford Copper Company, and Col. J. R. De La Mar. The officers of the International Nickel Company are: President Ambrose Monnell, formerly assistant to the president of the Carnegie Steel Company; chairman of the board, Col. R. M. Thompson; general counsel, Max Pam, of the United States Steel Corporation; treasurer, Stephen H. P. Bell; secretary, Joseph Claudet. Other directors are E. C. Converse, of the U. S. Steel Corporation, Joseph Wharton, of Philadelphia, Dr. Leslie D. Ward, A. W. Maconochie, J. R. De La Mar, and Millard Hunsiker, of London.

The other great producer of nickel, Société le Nickel, with its extensive properties in New Caledonia and its reduction works in France, which now divides with the Canadian Copper Company the duty of providing the world with this metal, is not included in the combination; but it is stated that a full understanding has been arrived at between the new company and le Nickel, as regards prices, production, and division of markets. Also outside the consolidation are the Mond Nickel Company, whose mines and works at Victoria Mines have been referred to, the Lake Superior Power Company, with mines in Creighton Township, smelters under way at the same place, and reduction works at Sault Ste. Marie. There are also the Nickel Copper Company, whose works at Hamilton to operate the Frasch process of refining have not yet been put into operation; the Dominion Mineral Company, and H. H. Vivian and Company, both of whom own lands and idle smelters in the Sudbury region; the Great Lakes Company, and other companies, firms and individuals.

The combination by no means controls all the nickel ore in the district, and there is plenty of room for independent companies. Locally, it is believed that not more than one-fourth of the known deposits have passed into the possession of the new company.

The formation of the new corporation and the transfer to it of the properties at Sudbury have been accompanied by a partial cessation of work at the mines and smelting plants. This has given rise to apprehension in some quarters that the consolidation will have a prejudicial effect upon the development of the nickel industry in this Province. It is of course too soon to say what the result will prove to be, but the stoppage of work is not likely to be more than temporary, and there is little or no doubt that the new company with the ample capital at its command will operate the mines quite as vigorously as its predecessor in ownership.

A PROMISING COPPER DISTRICT.

West of the nickel region generally spoken of as the Sudbury district which includes parts of the western side of Nipissing district and the eastern side of Algoma, lies a tract of Huronian rocks characterized in many places by deposits of copper sulphides. A typical example is that at Bruce Mines, which upwards of 40 years ago yielded large quantities of ore containing probably more than $3,000,000 worth of copper. Another vein of a similar nature has been opened up and is now being worked at Rock Lake, some twelve miles north of Bruce Mines, where a 200-ton concentrator began work about the beginning of the present year. A railway has been built to the mine from Bruce Mines on the Canadian Pacific Railway, which will be extended to deep water on Lake Huron, so as to afford shipping facilities. At present the concentrates produced at the Rock Lake Mines are being sent to Dollar Bay, Michigan, where they are smelted into copper, but a project is on foot for establishing a smelter either at Rock Lake itself or some other convenient point in the district at which the product from all the mines in the neighborhood could be reduced.

Other bodies of copper ore occur at the McMillan location in Aberdeen township, not far from the Rock Lake mine, at the Stobie mine near Desbarats station on the C P. R., in the townships of Montgomery, Gould, Morin, Haughton, Gladstone, Plummer, Salter, Victoria, in timber berth No. 153 and elsewhere over a district stretching from Massey station on the east to the east shore of Lake Superior on the west, and there is little doubt that if the region were better supplied with railway facilities, further exploration would take place which would bring many more deposits to light. It is well within the range of possibility, even probability, that this portion of Ontario will yet take important rank as a copper field. Other minerals occur, such as gold at the Ophir mine in Galbraith township once regarded as of promise, but not now being worked, and iron, of which there are prospects near Lake Huron and indications along the upper stretches of the Mississaga river and elsewhere. There is a tract of country lying west of the tiers of townships accessible from Sudbury and vicinity, south of the main line and north of the Sault Ste. Marie branch of the Canadian Pacific Railway, whose timber, mineral and agricultural resources are little known. There is reason to believe that extensive white pine forests exist in that region, all the more valuable because tributary to the north shore of Lake Huron. Most of the rivers, too, are marked by good water powers.

Of purely copper ores, mainly derived from the north shore district just spoken of, some 6,800 tons were raised during 1901, having an estimated value of $47,180. The number of workmen employed in the mines and to operate the plants was 432, to whom wages amounting to $142,964 were paid. These statistics are included in those for nickel and copper. Practically none of these mines were in the producing stage during the year, which fact partly explains the size of the wage bill as compared with the value of the output. The Bruce Copper Mines were in operation about four months in 1901, but are now idle. The concentrating plant ran a short time and produced over a hundred tons of concentrates, which were shipped to New York."

The Essentials for Successful Hydraulic Mining.

In his very excellent review of "The Gold Mines of the World," of which another very handsome edition has been issued, and of which we hope to have something more to say later on, Mr. J. H. Curle in discussing the question of hydraulic mining says :—

"Hydraulic mining is a distinct art. To my mind the laying out of an hydraulic mine is a greater test of capacity than the opening of a quartz mine.

In hydraulic mining there are three main essentials : *gold: water power* to force the gravel into the sluices; and *grade* to carry away the tailings. To determine the presence of these on any property, or the being able to bring together these three, often means a series of experiments stretching over several years. An hydraulic property cannot, therefore, be hurried to the producing stage.

But there are so many other questions, too. Gold, water, and grade may be there in abundance—all the essentials—but if the questions of ownership of adjoining property, litigation and finance are looked at, the whole fabric may fall to pieces, and the labor of years be of no use.

The owner of an hydraulic property must not only have title to his own ground, but he must be certain that his mining operations will not interfere

with the properties of any one else, either above or below him. This is a rock over which, I suppose, hundreds of otherwise payable mines have come to grief. In California, some years ago, a whole hydraulic industry had to close down because the properties of farmers, many miles away, were being flooded with *debris;* and even in Atlin, at the present moment, there are several bitter law cases because the silting up of tailings from one mine blocks the passage of tailings from another mine.

In bringing in water, too, one property may gain at the expense of another. Then comes litigation—the water is cut off, and the mine—on which perhaps a small fortune has been spent—has to be shut down.

Again, if a mine is to be laid out to the best advantage, there are the years of experiment to be faced. The depth of gravel and nature of the bed-rock have to be tested by innumerable holes, and temporary sluices have to be fitted up for trial runs; surveys have to be made for the bringing in of a head of water, and the volume of water tested the whole year round; the grade for the sluice boxes and the tailings race has to be laid out, or perhaps tunnelled, and the ultimate disposal of the tailings made sure. The Mining Commissioner and the lawyer have to be consulted at every fresh step. All this takes time, and a good deal of money. Directors, who rarely understand technical details, become impatient, and if the shares are weak on the market, the manager will probably have trouble in getting enough money to carry out his original and carefully thought-out programme."

NEW COMPANIES.

BRITISH COLUMBIA.

Vancouver Petroleum Syndicate, Ltd.—Incorporated 22nd Sept., 1902. Authorized capital, $25,000, in shares of $5.00 each.

ONTARIO.

The Hatch Electric Smelting and Refining Co. of Ontario, Ltd.—Incorporated 17th September, 1902. Authorized capital, $500,000, divided into $500,000 shares of $1.00 each. Head office: Parry Sound, Ont.

Gold Reef Mining Co., Ltd.—Incorporated 17th September, 1902. Authorized capital, $700,000.

International Portland Cement Co., Ltd.—Incorporated 24th Sept., 1902. Authorized capital, $1,000,000, in shares of $100 00 each. Head office: Toronto, Ont.

Union Oil Company of Canada, Ltd.—Incorporated 24th Sept., 1902. Authorized capital, $600,000, in shares of $1.00 Head office: Petrolea, Ont.

COMPANY NOTES.

Emma.—The daily output of ore from this mine, at Summit, is 160 tons. This ore is quarried from open workings and goes to the Hall Mining and Smelting Company's works at Nelson.

Granby Consolidated.—The new machinery house for the electrically driven compressor plant is about completed. The building is 60 by 120 ft. There will be two tandem duplex compound air compressors driven by two 750 h.p. induction electric motors, giving a 60-drill capacity. The machinery has been shipped from the factory at Sherbrooke, Que., including the necessary rope drives, seven air receivers, new drills and a 10-ton travelling crane.

A gravity tram from the upper part of the ore quarries to the ore bins and crusher house and a tray to the shipping bins have been in course of erection, and are about ready for the big Farrel crusher, having jaws with an opening 36 by 42 inches, which will be driven by a 100-h.p. electric motor. This crusher is the largest of its kind yet made in Canada.

The open workings at the mines now extend north and south about 1,300 ft., and have a width varying from about 50 ft. to about 100 ft. Besides this an area approximately 800 ft. long by 200 ft. wide has been stripped. Work in the main quarries has been carried on as usual. Large openings have been made from the Knob Hill main tunnel up to the quarries, giving in all twelve chutes.

Common Errors in the Determination of Silica.—In a comprehensive and interesting paper giving a large number of experiments, the author investigates the causes of the common occurrence of error in the determination of silica in silicate analyses, even after repeated evaporations, and draws the conclusion that intermediate filtrations are necessary to ensure the complete removal of the silica. He also recommends the use of the blast to obtain the correct weight of SiO_2.—W. F. Hildebrand, *Journal American Chem. Soc.*, April, 1902.

MISCELLANEOUS.

A Novel Air Compressor.—An interesting air compressor, containing no piston nor any moving part save valves, has recently been described in the *Revue Universelle des Mines et de la Metallurgie*. It is due to Mr. Emile Gobbe, and has been tried with some success at the Monceau Company's blast furnace. The arrangement consists of an explosion chamber, the outlet of which leads to a chimney. A throttle valve which tends to remain open by its own weight is introduced between the chimney and the explosion chamber. Two conduits, one for gas and the other for air, lead to this chamber. At some distance from the points at which they enter the combustion chamber each conduit is provided with an inlet and an outlet valve, the latter communicating respectively with the receivers for compressed air and compressed gas. A draught having in any suitable way been started up the chimney of the plant, charges of air and gas are drawn in and mix in the combustion chamber. The mixture is then fired by an electric spark. The explosion closes the valve to the chimney, and forces a portion of the air and gas back along their respective conduit pipes and through the discharge valves into their receivers. When the pressure falls sufficiently, the valve at the base of the chimney opens automatically again, and a fresh charge is drawn in and the action repeated as before. In the experimental plant erected at Monceau, the explosions followed each other at the rate of twelve to fourteed per minute; but the plant proved to be in need of considerable modifications if satisfactory working was to be obtained. In a laboratory apparatus since constructed and designed to work with town in place of blast-furnace gas, good results have been obtained in the matter of regularity of working, and the inventor claims that with a large plant carefully designed very considerable economy could be relied on, and the capital cost would be extremely small.

Cyanide Practice in the Telluride District, Colorado.—At the Liberty Bell Cyanide Works the method of treatment consists in draining the upper vats under suction, and adding lime at the rate of 4 lbs. per ton of sands. Weak solution (3 lbs. cyanide per ton) is then pumped on to displace the water retained in the sands. This is washed to waste until cyanide is detected and run through the waste solution 2-inch box. At a strength of 1 pound per ton it is diverted into the weak solution box. After several days treatment, the upper vat is drained and lowered to the vats underneath and the sands are washed with strong solution containing 6 pounds of cyanide per ton. The treatment here lasts four days and the strong solution is displaced by weak washes and water until the strength falls to .7 lbs. per ton when the vat is ready to sluice out. The strong solutions have a total alkalinity equal to about 5 lbs. lime per ton of which about half is due to cyanide and half to dissolved lime so that the solutions are considered to be virtually a saturated solution of caustic lime. The cost of cyaniding 4,000 tons per month is between 60 and 70 cents per ton and the consumption of cyanide varies between .75 and 1.25 pounds per ton of ore treated. The zinc consumption is .03 or .04 pound per ton. The extraction averages about 67 per cent., the residues containing about 85 cents per ton.—*Mines and Minerals*, Denver, Colorado, April, 1902.

Accidents with Explosives.—Among the accidents reported by H M. Inspectors of Explosives for the year 1901, the following is said with regard to "hang fires," and returning too soon to shot-holes. Under this heading are included those cases where miners have returned to the shot-hole believing that the shot has missed fire or not been ignited or that it has fired. In nearly all such cases a hang-fire has probably occurred. Of these accidents only one was remarkable, in that it occurred with a cartridge of amvis fired electrically. In this case the detonator fired, and ten or fifteen minutes later, when the men had returned, the cartridge itself exploded. This is not an unprecedented occurrence, and information from Germany shows that similar phenomena have been observed there with ammonium nitrate explosives. The cause is obscure, and experiments have failed to reproduce the effect.

E. J. WALSH

CIVIL AND CONSULTING ENGINEER

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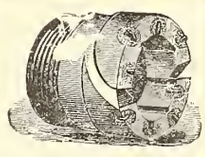
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Liquidator of The Crystal Gold Mining Co. of Rathbun, Limited.

Dated PEMBROKE, June 26th, 1902.

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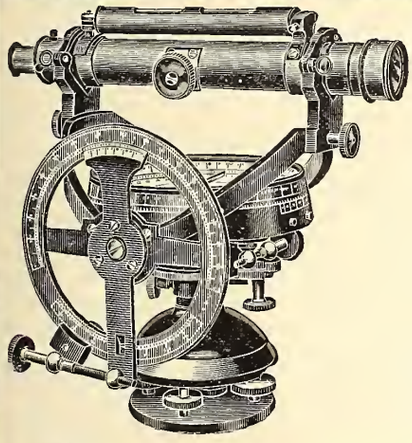
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For further information see the Calendar of Queen's University.

4. POST-GRADUATE COURSE FOR THE DEGREE OF Doctor of Science (D.Sc.)

For further information see the Calendar of Queen's University.

Next Session begins October 1st, 1902.

MATRICULATION EXAMINATIONS HELD AT QUEEN'S UNIVERSITY SEPTEMBER 16TH

THE SCHOOL is provided with well equipped laboratories for the study of Chemical Analysis, Assaying, Blowpiping, Mineralogy, Petrography and Drawing. It has also a well equipped Mechanical Laboratory. The Engineering Building will be ready for occupation next session and the Geology and Physics Building the following session. The Mining Laboratory has been remodelled at a cost of some $12,000 and the operations of crushing, amalgamating, concentrating, chlorinating, cyaniding, etc., can be studied on a large scale.

For Calendar of the School and further information, apply to

The Secretary, School of Mining, Kingston, Ont.

Did You Hear the Thunder?

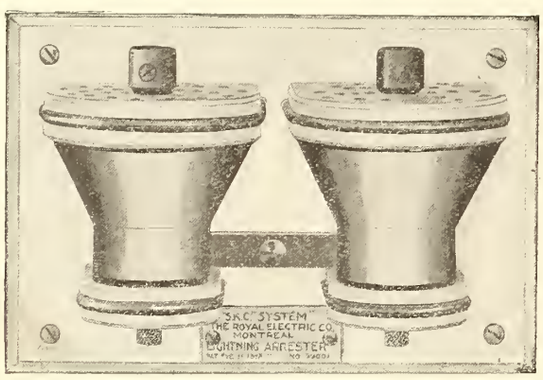
Where there is thunder there is lightning. Every electric plant should be provided with Lightning Arresters which will **PROTECT!**

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TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

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The attention of Miners and Capitalists in the United States and in Europe is invited to the

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Open for investment in the Province of Quebec.

Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less, but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in-Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental – such royalties, unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at th mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order-in-Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end of the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 per acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee, $5.00, renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings, but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed or bars in the rivers below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River, and Hill claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim must hold a Free Miner's certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of 2½ per cent. on the value of the gold shipped from the Territory to be paid to the Comptroller.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek, or gulch, but the same miner may hold any number of claims by purchase, and Free Miners may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch, or river, by giving notice, and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00, and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette*.

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, at the rate of 2½ per cent. on the value of the gold shipped from the Territory. Operations must be commenced within one year from the date of the lease, and not less than $5,000.00 must be expended annually. The lease excludes all base metals, quartz, and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery, at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council

JAMES A. SMART,

Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite: copper in sulphide and native form; gold, mostly in free milling quartz; silver, native and sulphides; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc, apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

CONTRACTORS TO H. M. GOVERNMENT

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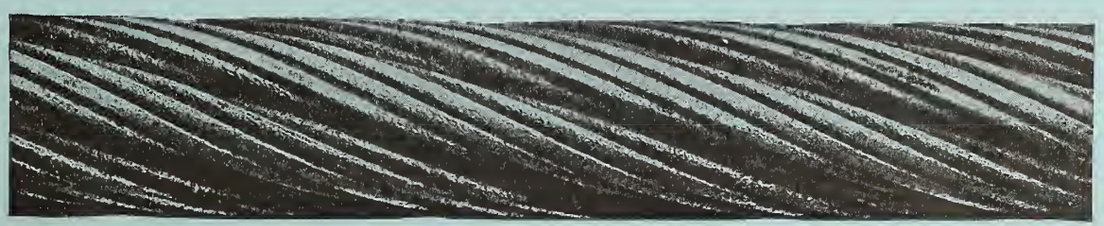
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Wire specially selected for own exclusive use.
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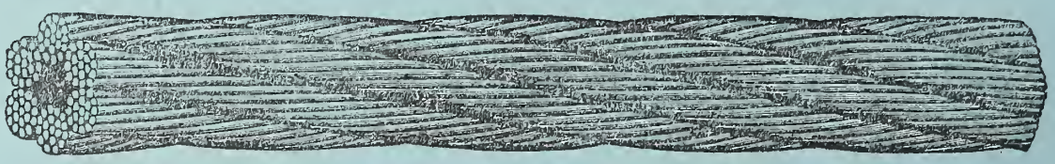
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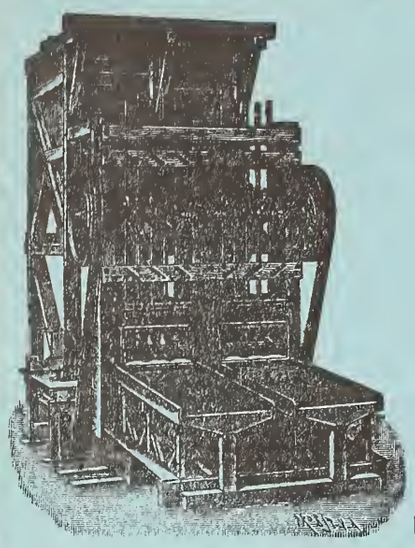
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Complete Gold Ore Dressing Plant

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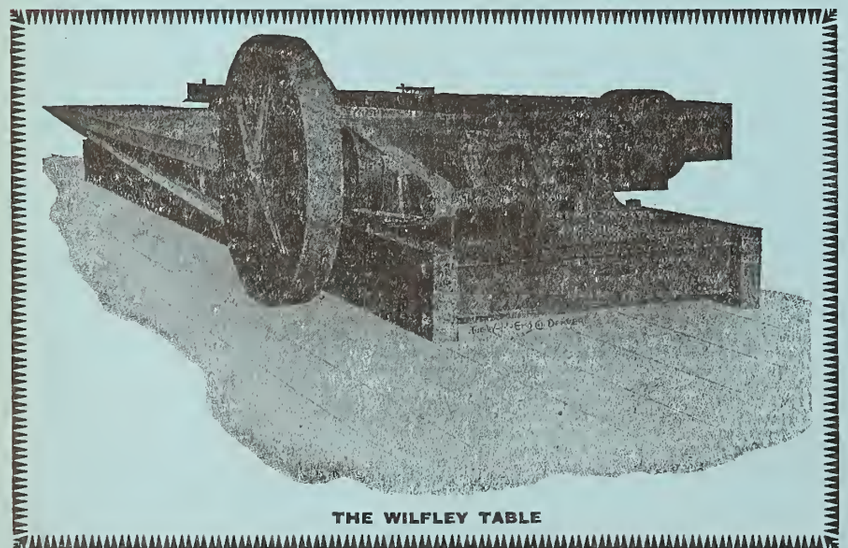
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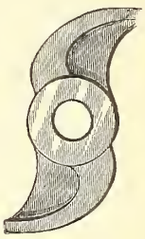
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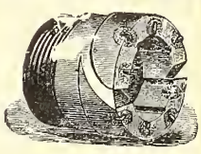


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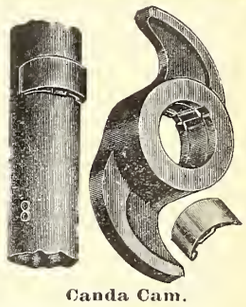


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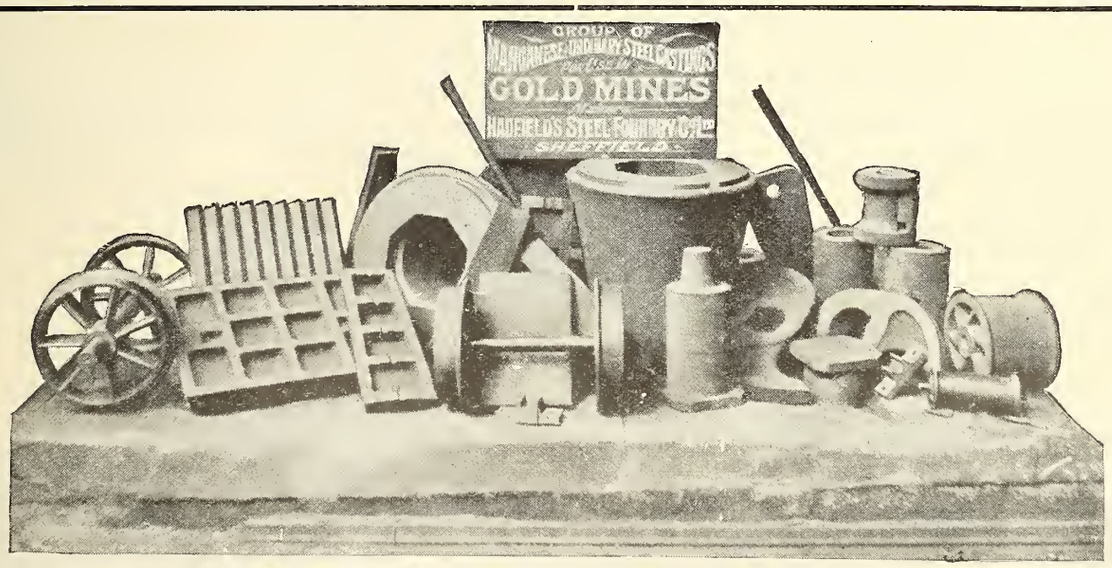
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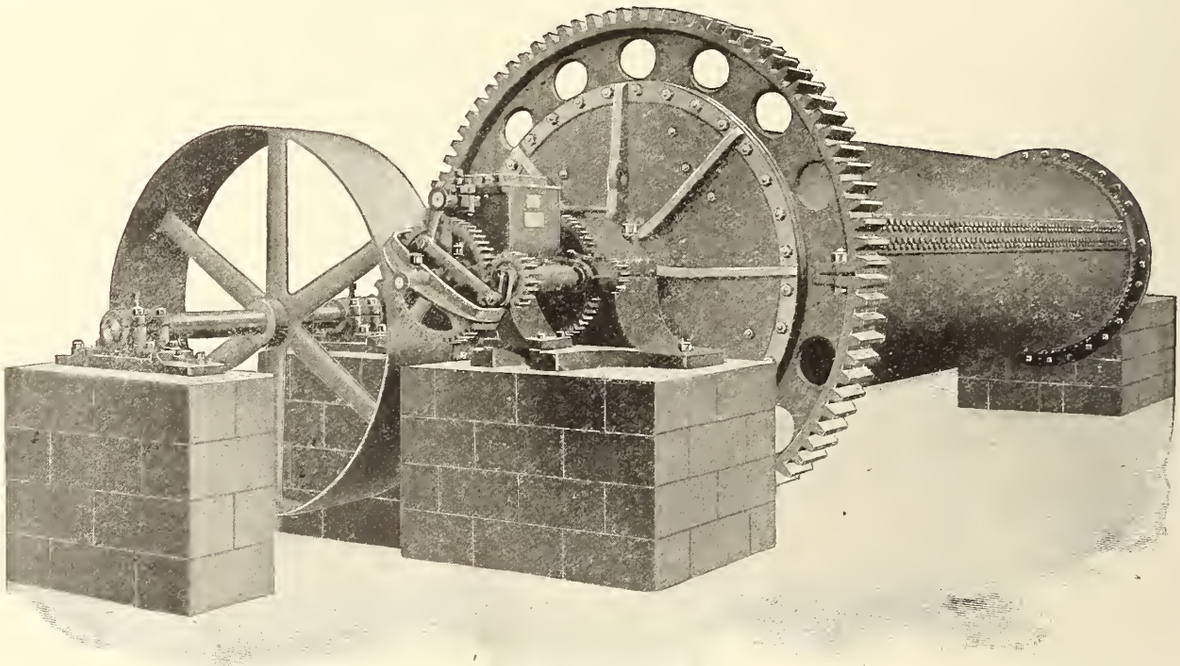
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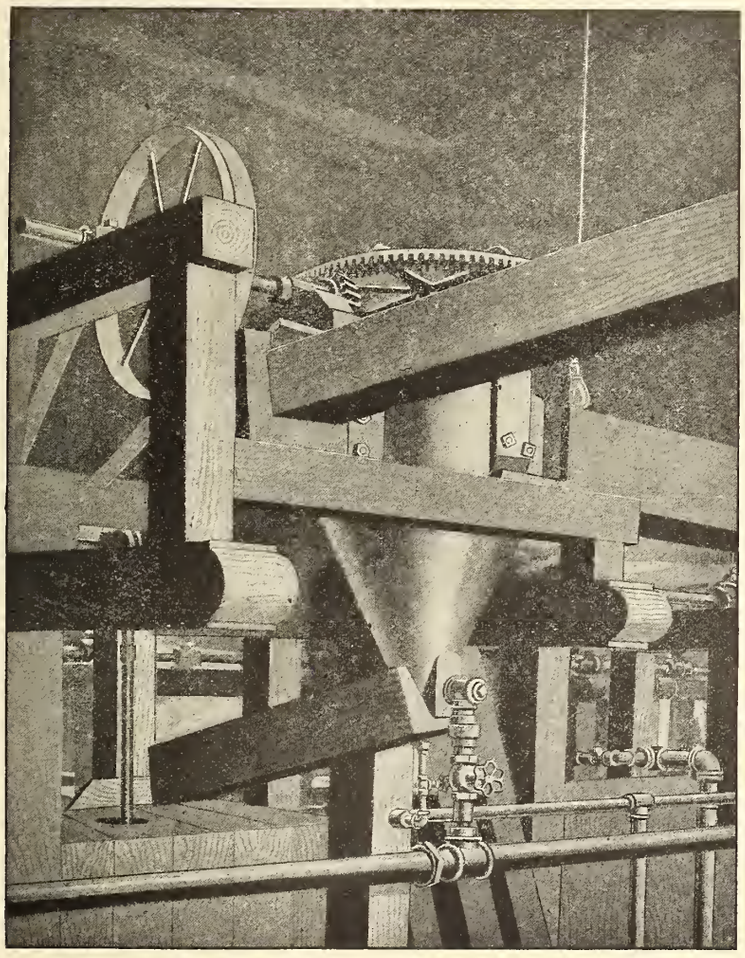
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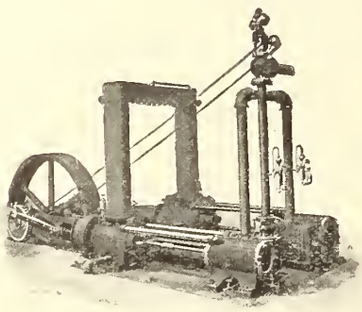
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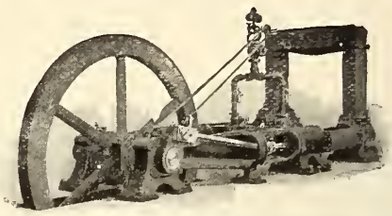
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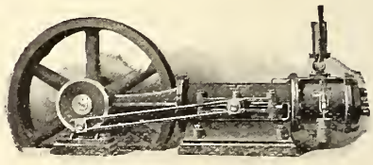
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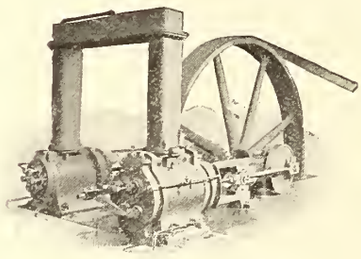
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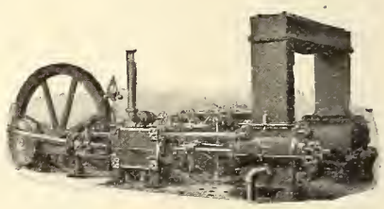
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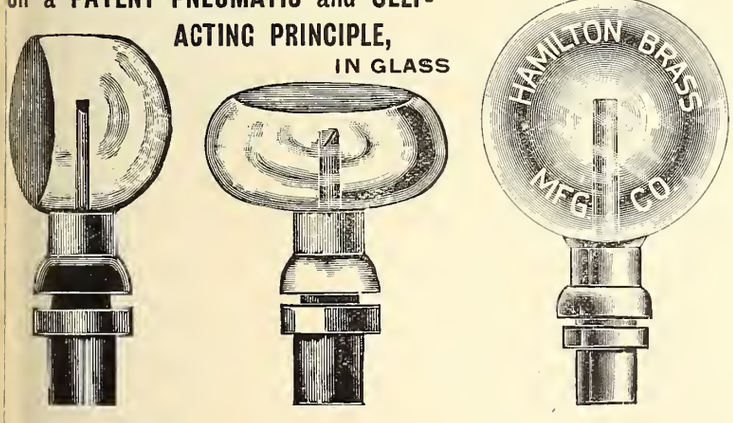
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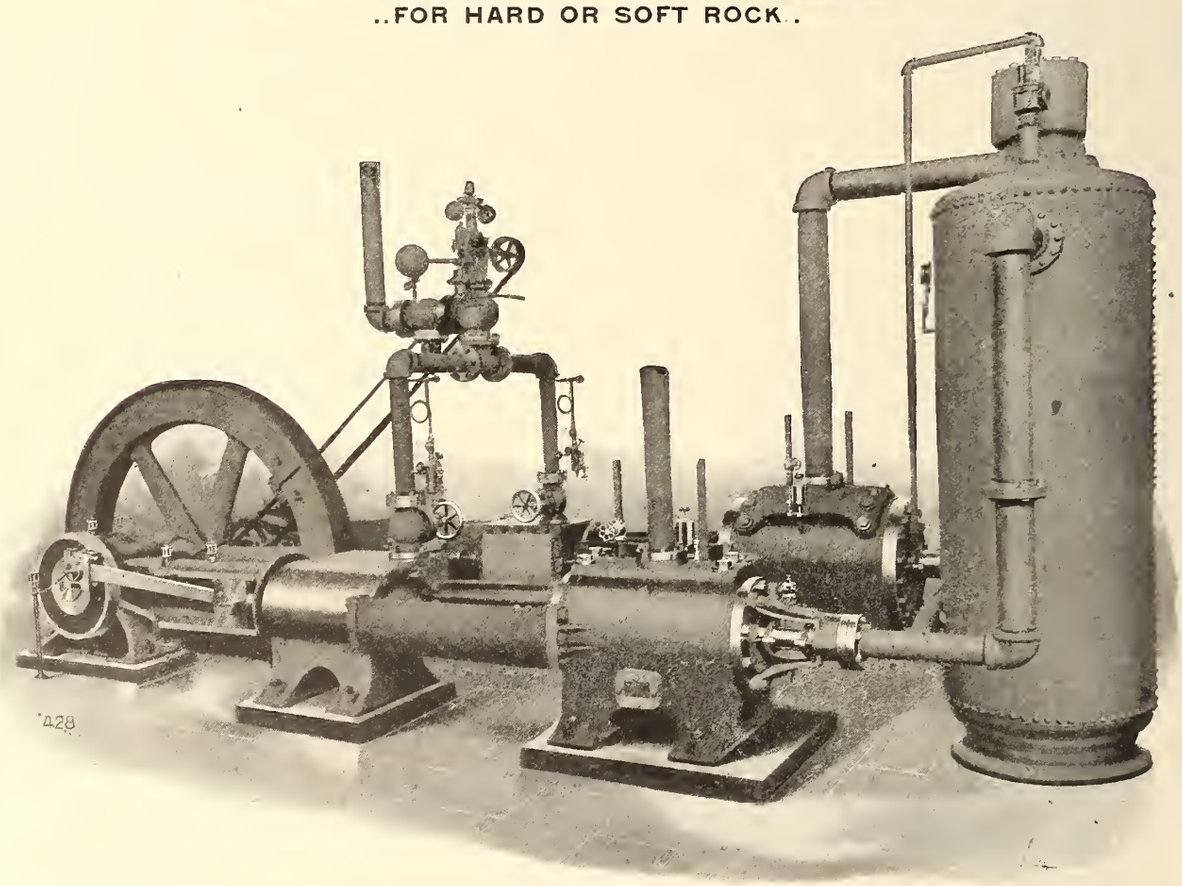
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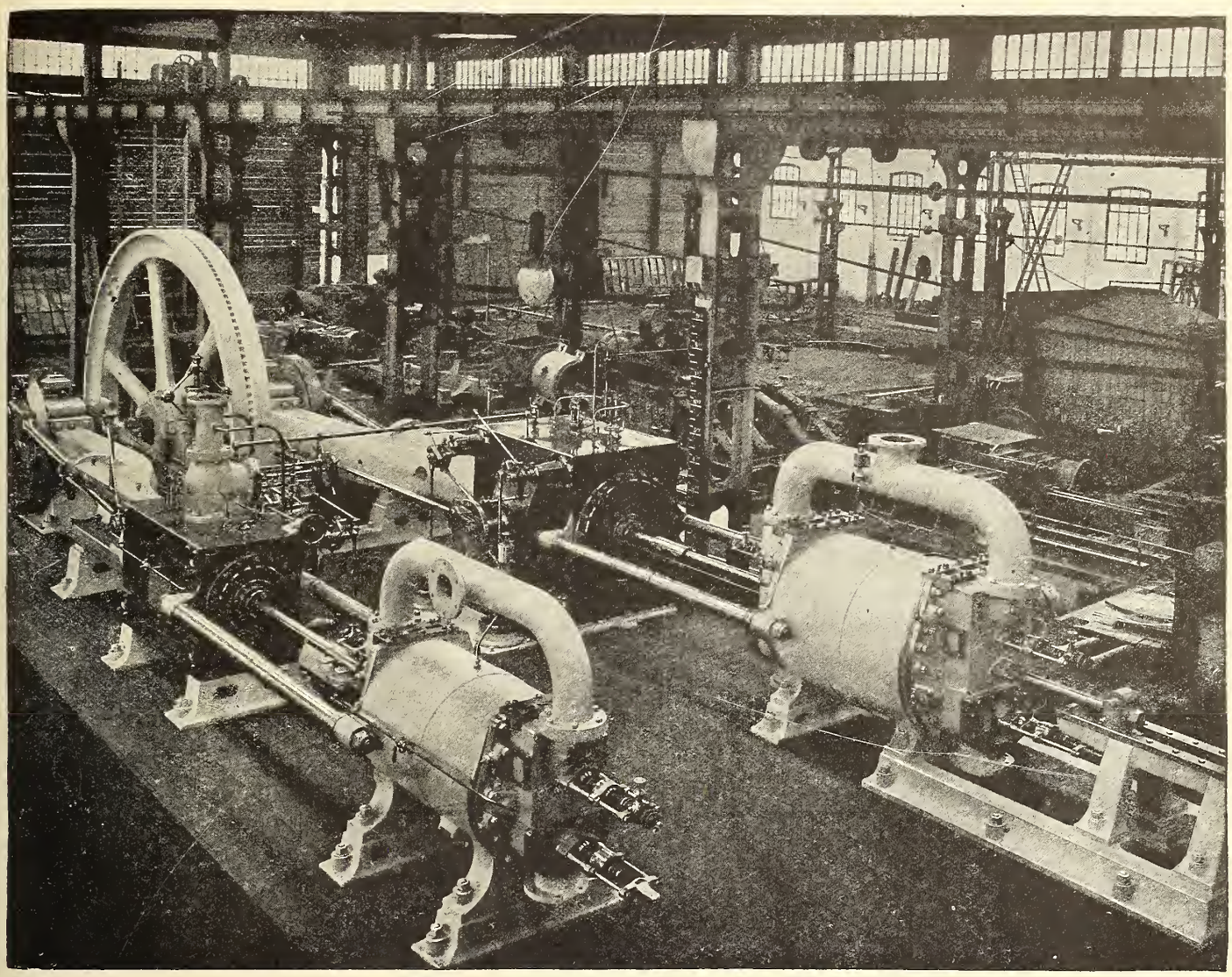
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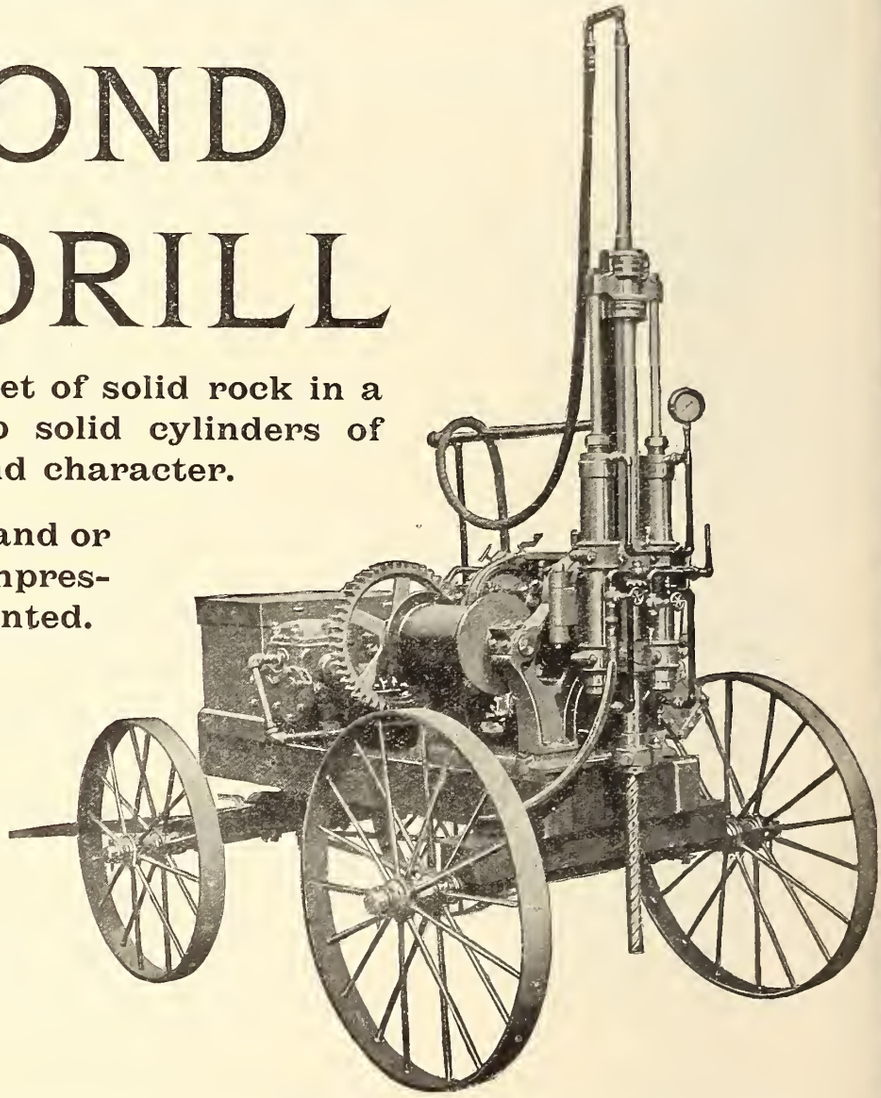
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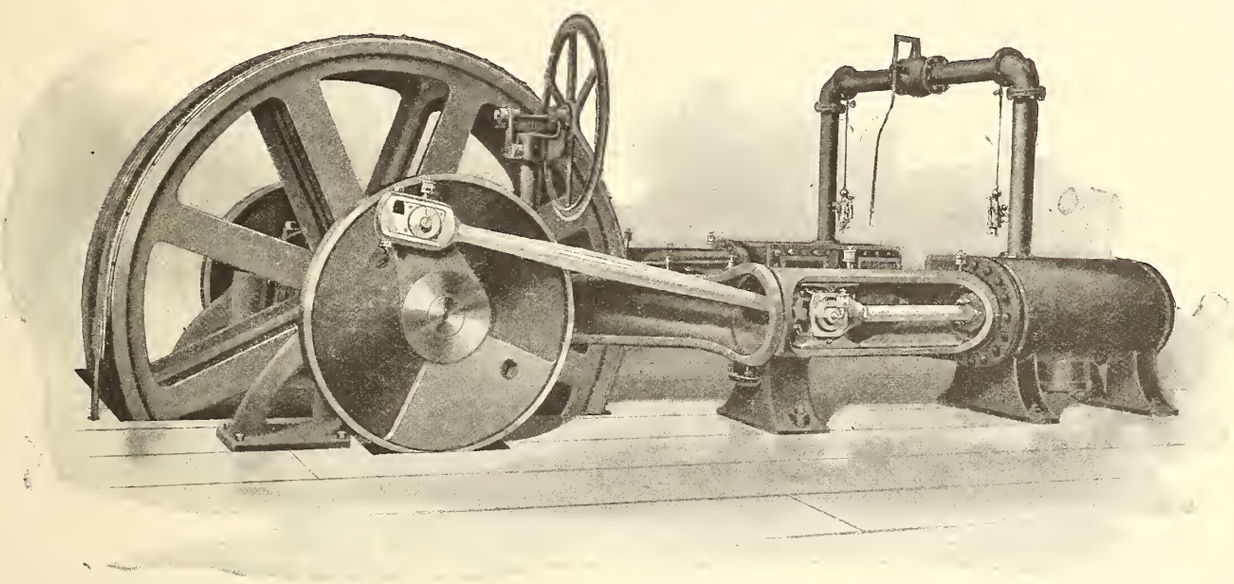
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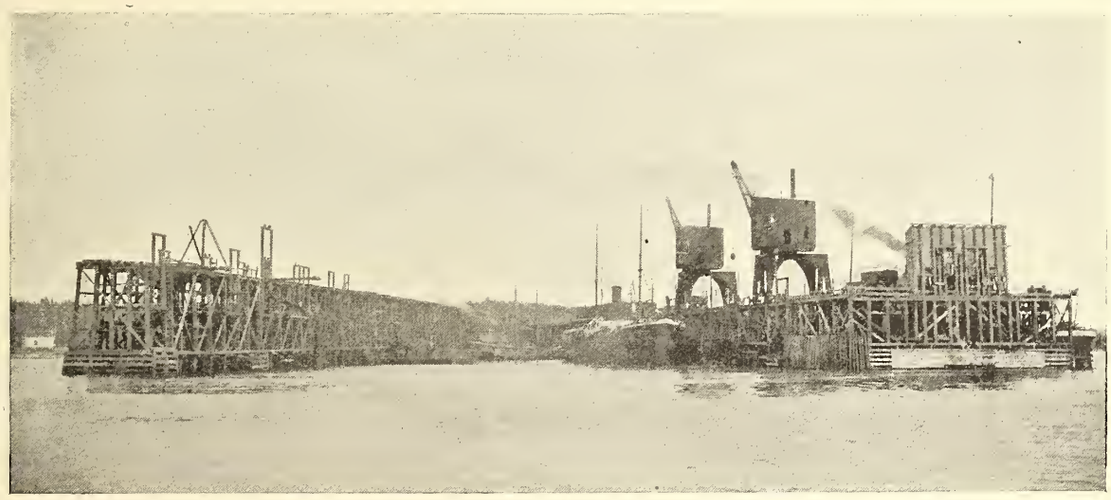
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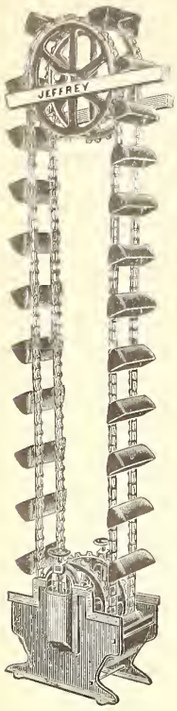
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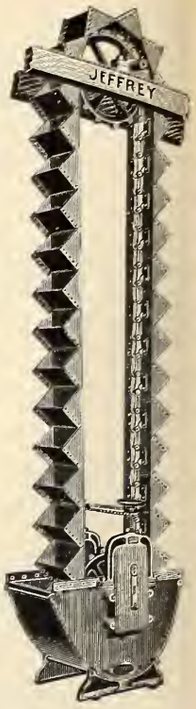
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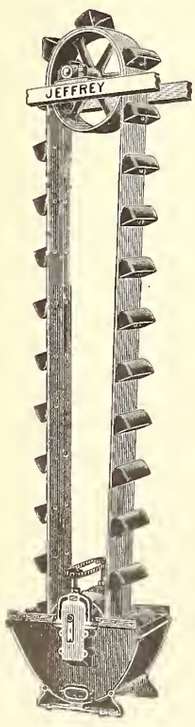
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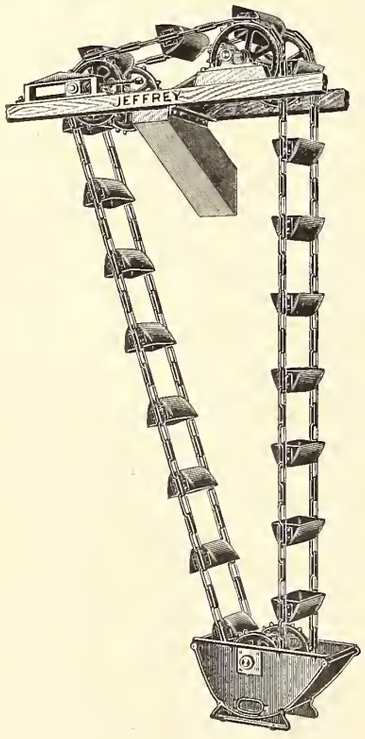
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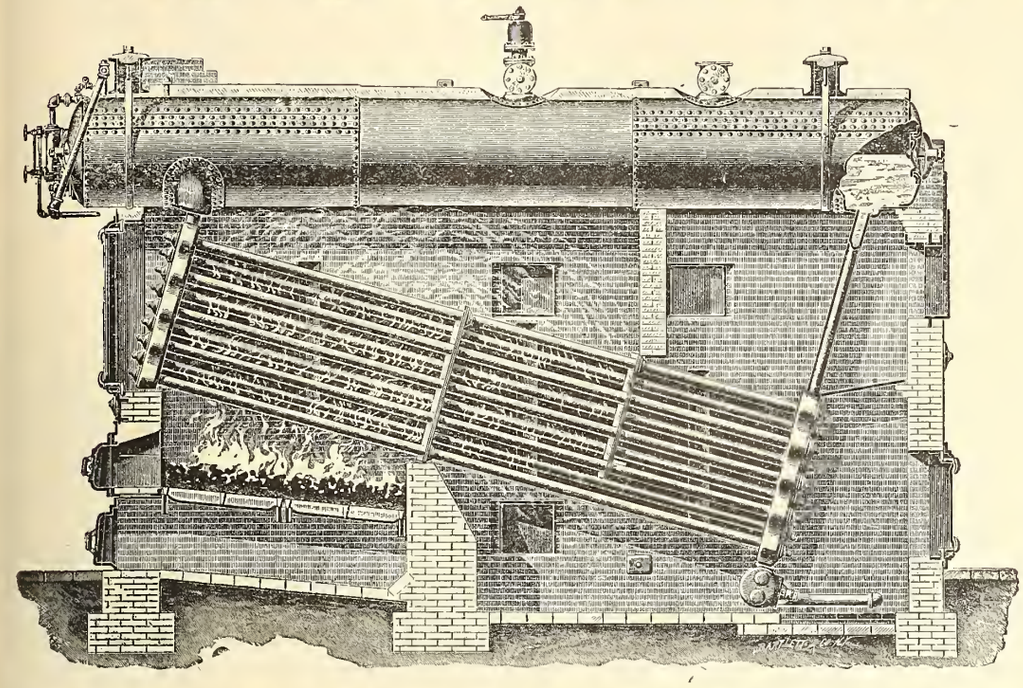


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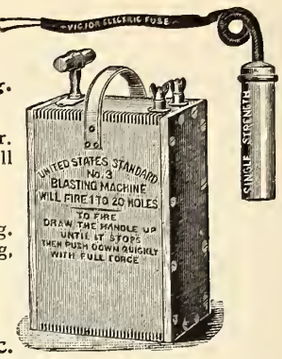
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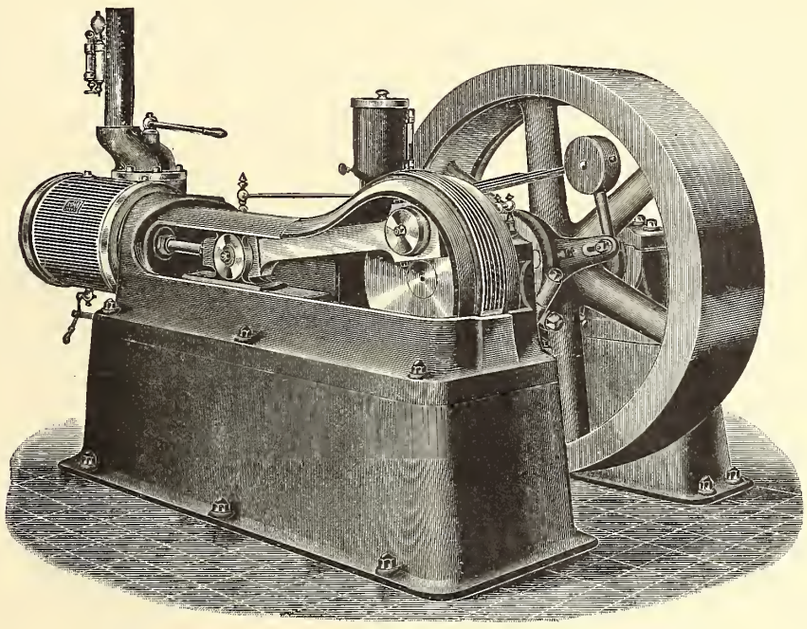
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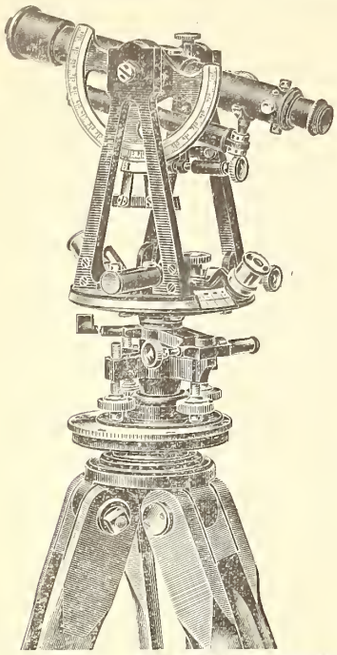
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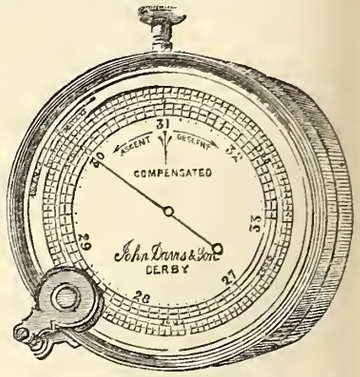
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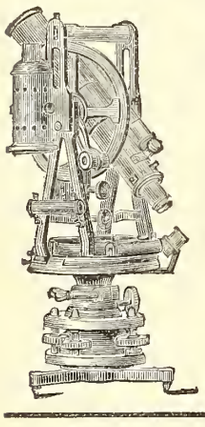
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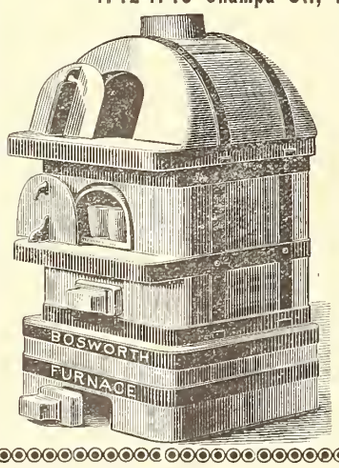
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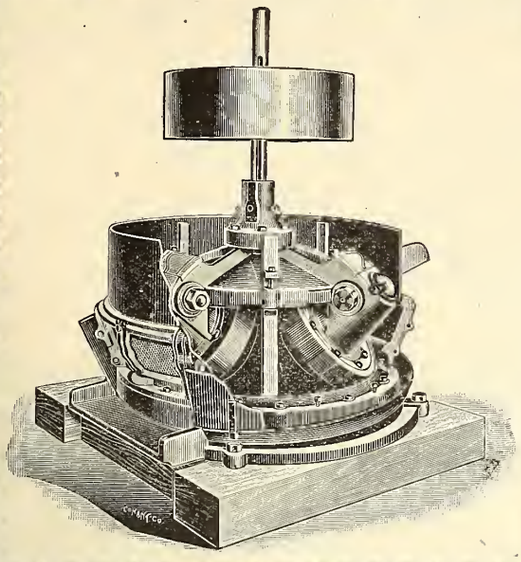
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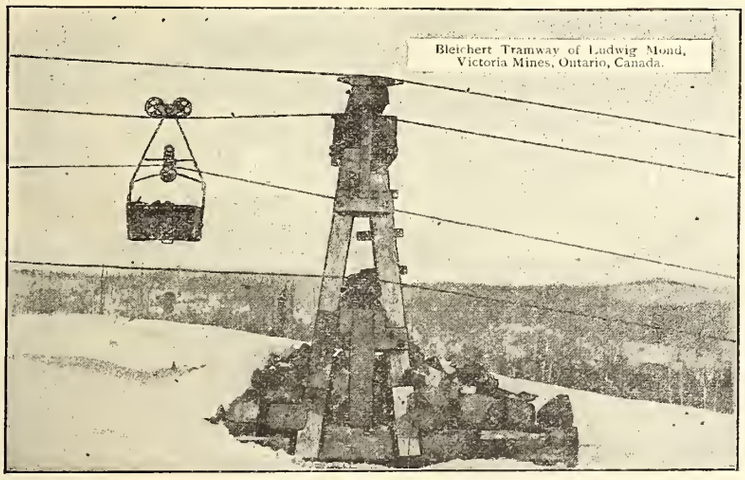
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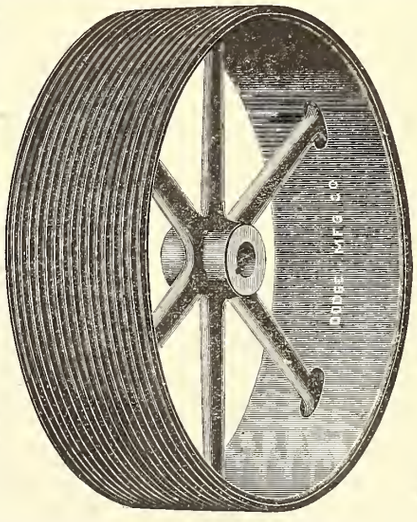
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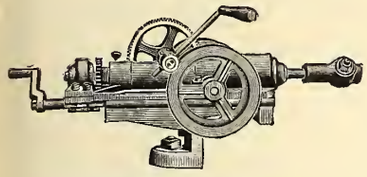
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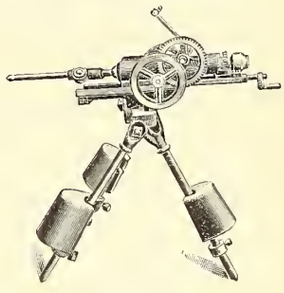
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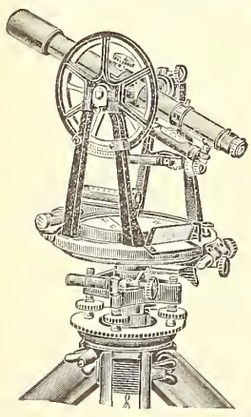
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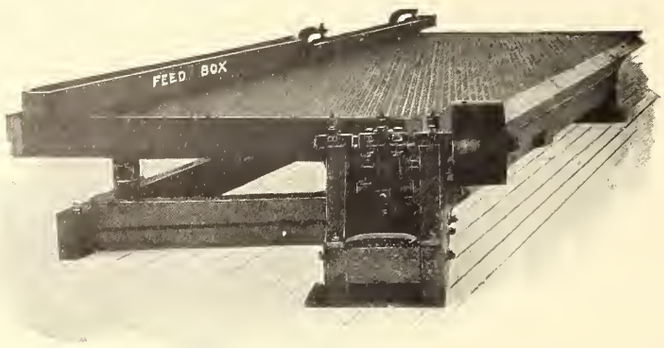
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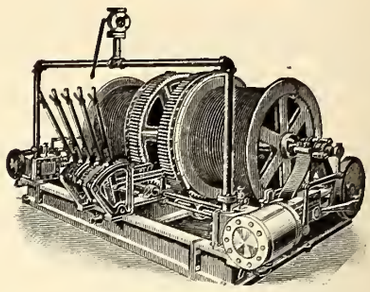
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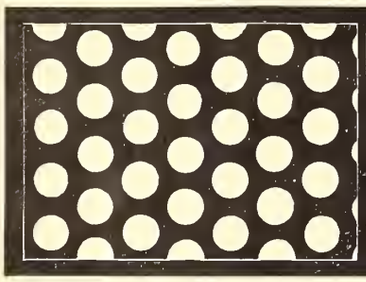
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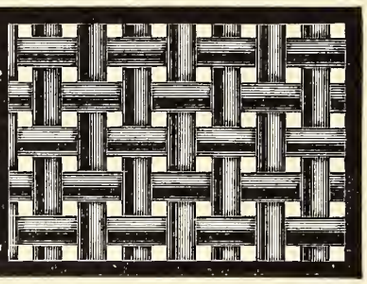
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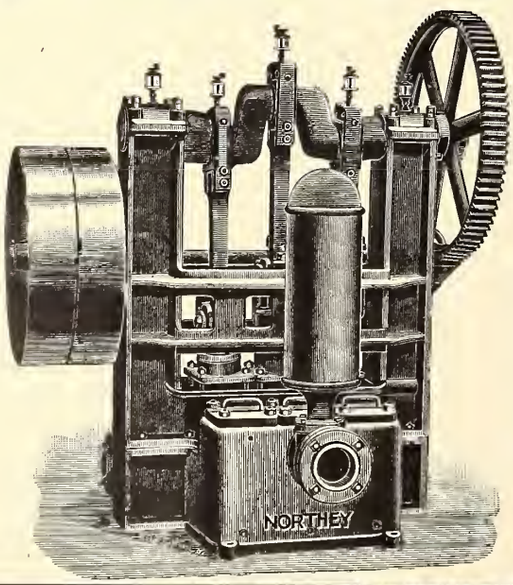
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The CANADIAN MINING REVIEW

Established 1882

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Our Cement Industries.

The enormous growth in the production of cement during the past few years is due, in part at least, to the extensions of its use into departments of construction into which other materials have hitherto been used. A summary of the statistics of the production and prices in Ontario, the largest producer, during the ten years from 1892 to 1901 will show that while the production has been increased six and a half times, the prices have ruled very steadily.

YEAR.	Natural Cement.			Portland Cement.		
	Bbls.	Value.	Per Bbl.	Bbls.	Value.	Per Bbl.
1892	54,155	$38,580	$0.71	20,247	$47,417	$2 34
1893	74,353	63,567	0.86	31,924	63,848	2.00
1894	55,323	48,774	0.88	30,580	61,060	1.82
1895	55,219	45,145	0.82	58,699	114,332	1.95
1896	60,705	44,100	0.73	77,760	138,230	1.78
1897	84,670	76,123	0.90	96,825	170,302	1.76
1898	91,528	74,222	0.81	153,348	302,096	1.97
1899	139,487	117,039	0.84	222,550	444,227	2.00
1900	125,428	99,994	0.79	306,726	598,021	1.95
1901	138,628	107,625	0.78	350,660	563,255	1.61

Since 1899 there has been no increase in the manufacture of natural cement, while the output of Portland cement has gone up about fifty per cent. In 1899 the prices ruling for both varieties of cement were practically the same as in 1893. Natural cement is just now quoted at $1.35 to $1.60, while Portland, according to quality, brings from $1.90 to $2.75. The increase in production has been mostly in Portland cement, the output of which in 1901 was more than seventeen times the quantity manufactured in 1892. But in spite of this great advance the importation of cement from Great Britain, the United States, Belgium, Germany and other countries has continued to increase, so that for the seven months ending January 31st, 1902, Canada imported cement to the value of $610,041, the United States furnishing five-sixths of the total.* The low prices ruling in Canada in 1901 may be explained by overproduction in the United States and the consequent necessity of finding a market for the overplus.

But the markets will stand a steady and large increase in the world's output. There is a growing demand for Portland cement not only for foundations, but for the walls of buildings. Reinforced by steel rods it is being extensively used for construction in many cases where great strength and solidity are required. In Europe piles are being made of steel and cement, and are found to stand driving better than wood.

While the cement industry is growing in Canada as fast perhaps as is healthy, the selection of sites and material for cement works would be greatly facilitated by a better knowledge of our clay, marl, and limestone deposits. Here is a large piece of work to which we call the attention of our national and provincial departments of mines. It has a direct bearing on an industry which is already producing nearly three quarters of a million dollars' worth a year, and which is capable of great expansion. The returns from such a piece of work are not problematical and they are not in the far distant future.

*Report of the Ontario Bureau of Mines, 1902, p. 33.

Canadian Trade in Mining Machinery.

The value of the mining and metallurgical industries of Canada and their rapidly increasing importance to the trade and commerce of the Dominion are very clearly demonstrated in the remarkable expansion which has taken place during the last few years in our trade, both domestic and foreign, in mining machinery and mine supplies.

The steadily increasing value of our production of minerals and metals, now approximating at the pit's mouth close upon $80,000,000 annually, the continued opening up and development of new mineral territory, the large expenditures on the installation of modern plants for our mines, mills, furnaces and smelters, have developed not only a very well organized and flourishing industry in the manufacture of special lines of mining equipment within the Dominion but also a large and growing trade with other countries. During the past two fiscal years official returns show that our enterprising neighbours in the United States supplied us with mining machinery of the value of two and a half millions of dollars. It is also gratifying to note that our imports from the mother country, while still not very large, are steadily improving.

The Canadian Customs tariff, while giving, very properly we think, a reasonable measure of protection by imposing a moderate duty upon those lines of mining machinery which are made at home, provides a very liberal Free List under which the bulk of the machinery noted below has been brought in. This List, we understand, will be still further extended during the next revision of our Customs tariff. The following figures have been carefully compiled by the Review from

the Trade and Navigation blue book annually published by the Department of Customs:—

Free machinery imported in	1898	of a value of		$128,780
"	"	1899	"	207,737
"	"	1900	"	724,187
"	"	1901	"	1,535,225
"	"	1902	"	904,267

These figures are for the fiscal year ending 30th June.

The following figures show the value of the free and dutiable mining machinery imported during the past two years and the sources from which it was derived:—

	1901	1902
Imported free of Duty—		
From Great Britain	$33,181	$14,061
" France	2,136	.....
" Austria	.....	50
" Germany	3,244	10,163
" United States	1,496,664	793,881
Total free machinery	$1,535,225	$848,155
Imported subject to 25 per cent. duty—		
From Great Britain	25,913	7,531
" Germany	.....	81
" United States	56,600	48 500
Total imports of mining and smelting machinery	$2,617,738	$904,267

The figures in detail for the nine months from 1st January to 30th September last and the entries during the same period of the previous year show:—

Month	1901			1902		
	Free	Dutiable	Total	Free	Dutiable	Total
January	$111,134	$4,196	$115,330	$92,984	$2,549	$95 533
February	162,030	9,689	171,719	43,123	2,380	45,503
March	62,185	806	62,991	55,255	2,629	57,884
April	52,921	517	53,438	61,227	5,087	66 314
May	259,309	6,180	265,489	90,820	4,782	95,602
June	162,674	12,269	174,943	77,270	5,293	82,563
July	58,919	4,267	63,186	47,511	2,171	49,682
August	70,979	16,428	87,407	90,798	1,139	91,937
September	84,479	599	85,078	82,090	8,906	90,996
Total	$1,024,630	$54,951	$1,079,581	$641,078	$34,936	$676,014

The following table shows in detail the sources from which Canadian mining and smelting machinery were derived during the last nine months of the year:—

Month	United States		Great Britain		Other Countries	Total
	Free	Dutiable	Free	Dutiable		
January	$66,236	$2,549	$26,328	...	$420	$95,533
February	42,486	2,380	637	...	...	45,503
March	54,980	1,720	275	$909	...	57,884
April	55,618	4,997	5,579	90	...	66,314
May	90 623	4,782	197	...	...	95,602
June	76,409	5,293	811	...	50	82,563
July	47,444	2 171	...	...	67	49,682
August	81,627	1,139	9,162	...	9	91,937
September	81,608	8,535	180	371	302	90,996
For 9 mos.	$597,061	$33,566	$43,169	$1,370	$848	$676,014

While these figures show a falling off in the value of our imports compared with the same period in 1901, it is well to remember that last year was especially notable for opening up and equipment of many new furnaces and smelters, and that in the earlier months of the present year mining activity in British Columbia was greatly restricted by labor troubles and a severe depression in the market for our silver-lead ores. This trade is, however, only in its infancy, and the continued expansion of mining activity throughout the Dominion will materially increase the value of our trade in mining machinery in the future.

Pig Iron Production.

The American Iron and Steel Association has received direct from the manufacturers the statistics of the production of pig iron in Canada in the first six months of 1902. The figures show a slight increase as compared with the last half of 1901, but a very great increase as compared with the first half of that year.

In the first six months of 1902 the production of all kinds of pig iron in the whole of the Dominion amounted to 157,894 gross tons, as compared with 149,952 tons in the last half of 1901, 95,024 tons in the first half of that year. The increase in the first half of 1902 over the last half of 1901 was 7,852 tons, or over 5 per cent, while the increase over the first half of 1901 was 62,780 tons, or over 66 per cent. Of the total production of the first half of 1901, 12,000 tons were Bessemer and basic pig iron. The coke furnaces made 147,392 tons and the charcoal furnaces 9,912 tons. Neither spiegeleison nor ferro-manganese has been made in Canada for several years.

The unsold iron held by the Canada pig iron manufacturers on June 30, 1902, none of which was intended for their own gross consumption, amounted to 37,721 gross tons, as compared with 59,472 tons on December 31, 1901. Of the unsold iron on hand June 30, 1902, less than 2,000 tons were made with charcoal, the remainder being coke iron.

On June 30, 1902, Canada had 14 completed blast furnaces, of which eight were in blast and six were idle. Of this total nine were equipped to use coal for fuel, four to use charcoal and one to use mixed charcoal and coke. In addition three coke and two charcoal furnaces were being built on June 30, 1902 but work upon two of the coke furnaces was temporarily suspended.

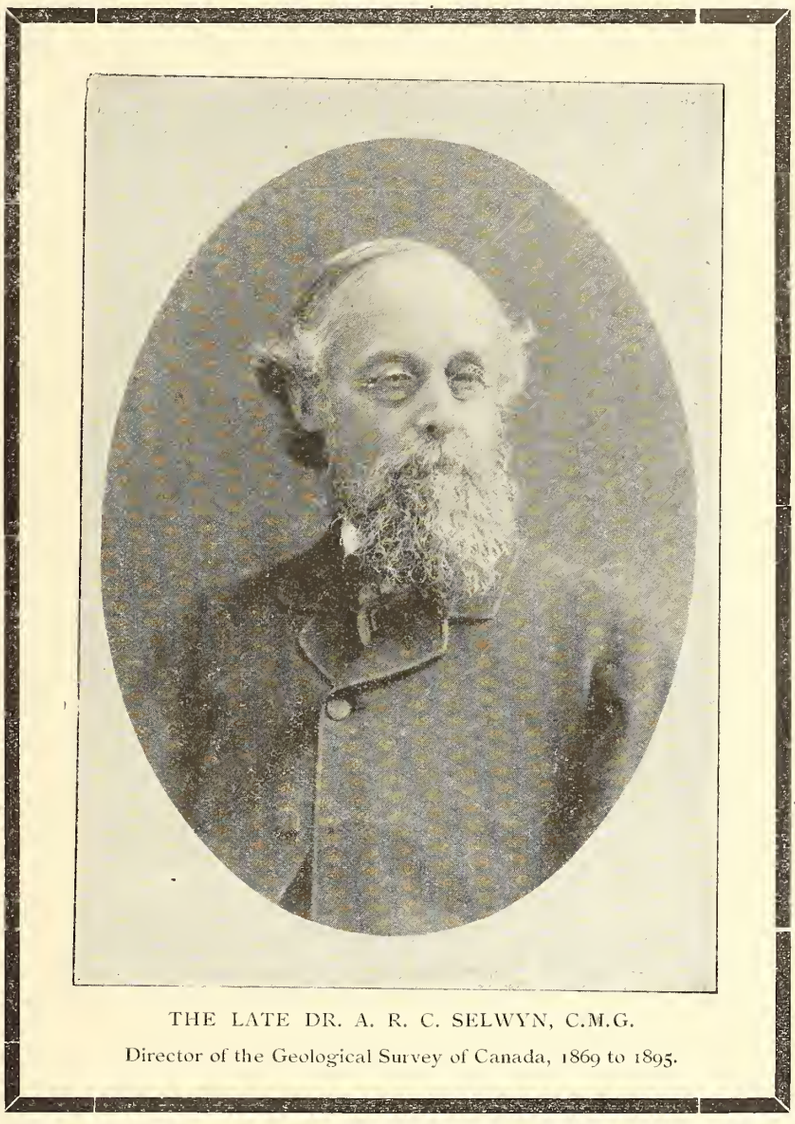
The Ophir Fight.

The Judicial Committee of the Privy Council have rendered a final decision in this long pending litigation in favor of the Ontario patentees, Messrs. E. Seybold *et al.*, who were represented in the Crown Land Department and in the Courts by Mr. J. M. Clark, K.C. The origin of the contest dates back to the "Boundary Dispute" between the Province of Ontario on the one hand and the Dominion of Canada and the Province of Manitoba on the other. This dispute was decided in favor of Ontario in 1878 by arbitrators but their award was repudiated by the Dominion. The matter was then referred to the Judicial Committee of the Privy Council, their decision in favor of Ontario being confirmed by Imperial legislation. The Dominion then claimed the land by virtue of the so-called Indian title. This claim was fought in the Courts and was decided both in the Canadian Courts and by the Privy Council in favor of Ontario. The last point in the series of questions arose in the present case in regard to a tract of land including Sultana Island which the Dominion authorities purported to set apart as an Indian reserve although the lands belonged to Ontario. This question is now finally decided. The statement of the law in regard to the question contained in McPherson & Clark's Law of Mines in Canada was approved in Canada and has now been confirmed by the Privy Council, the final authority in such matters.

The Late Dr. Selwyn.

We are deeply grieved to record this month the death of our old friend, Dr. A. R. C. Selwyn, for many years Director of the Geological and Natural History Survey of Canada. Dr. Selwyn, who was in his seventy-eighth year, had been living since his retirement from the Survey at Vancouver, B.C., and he died there on the 24th ultimo. He had been in failing health for some time and the sad event was not unanticipated.

Alfred Richard Cecil Selwyn, C.M.G., LL.D., F.R.S., was born in Somersetshire, England, in 1824. He was the youngest son of the Reverend Townshend Selwyn, Canon of Gloucester Cathedral. His mother was the daughter of Lord George Murray, Bishop of St. David's, and grand-daughter of John, fourth Duke of Athol. His early education was received from a tutor at home, but later he was sent to Switzerland, where he completed his studies. After leaving school, some years were spent partly in travel in Belgium, France, Switzerland and the Tyrol, and partly in the position of a clerk in mercantile houses in London and Liverpool. This latter occupation, however, was distasteful, and having already acquired considerable knowledge of geology as an amateur, Mr. Selwyn gladly availed himself of an appointment as Assistant Geologist on the Geological Survey of Great Britain. The ability he displayed in this position soon attracted the notice of distinguished geologists, and in 1852, on the recommendation of Sir H. T. De la Beche, the Director of the Survey, Mr. Selwyn was appointed by the Secretary of State for the Colonies, to undertake the geological survey of the colony of Victoria, Australia. About this time much interest had been aroused respecting the gold fields and coal beds in Tasmania, and the Government of that colony decided to obtain the services of a practical geologist to decide the question. Mr. Selwyn was asked to undertake the work, and consenting, at once began a thorough and systematic examination of Tasmania, his report on which was highly satisfactory. In 1859 he undertook with equal success a similar service for the Government of South Australia. Previous to this, in 1856, he was appointed one of the commissioners of mines for Victoria; in 1858 he was made a member of the Science and Prospecting Board, and in 1861 appointed a commissioner for the Victoria International Exhibition. The esteem in which Dr. Selwyn was held by the Government and people of the colony is best shown by these and other distinctions accorded him.



THE LATE DR. A. R. C. SELWYN, C.M.G.
Director of the Geological Survey of Canada, 1869 to 1895.

He was a member of the Government Tender Board and of the councils of the Board of Agriculture, of the Royal Society, and of the Acclimitization Society. In 1869, Sir William Logan having resigned, the position of Director of the Geological Survey of Canada was offered to Dr. Selwyn, and he accepted. His work since then is well known; the lines laid down by his predecessor have been carried out to a large extent, but the field has so greatly enlarged that the present system may fairly be said to have originated with Dr. Selwyn. The responsibilities of such a position were very great, and his task had been rendered more arduous by the small sums appropriated by Parliament for the purposes of the Survey. A regretable dissension also at one time greatly added to the difficulties of his position; and this, together with certain ill-advised criticisms made either in malice or ignorance, which had appeared, caused the appointment of a Royal Commission in 1884 to enquire into the system and work of the Survey, the report of which silenced these complaints. Very mistaken ideas as to the objects and functions of the institution had been held. The Geological Survey is carried on in the interests of science more than of commerce. It never was intended that it should be a sort of National Prospecting Agency, for the purpose of discovering and appraising mineral deposits, and collecting commercial statistics, though this latter feature has been introduced and is carried out to a great extent, but rather that by it the geological structure of the country should be mapped out, thus indicating to the prospector the general areas in which he might reasonably expect to find the mineral he sought.

While administering the details of the Survey and Museum, Dr. Selwyn took an active part in the work of exploration. Amongst the most important of his expeditions were: In 1871 from Victoria, B.C., to the Rocky Mountains by the North Thompson and Fraser rivers; in 1872 a canoe voyage from Port Arthur to Winnipeg; in 1873 from Winnipeg across the plains to the Rocky Mountains, returning by the Saskatchewan River and Lake Winnipeg; 1875 from Victoria, B.C., to Peace River and return; in 1882 a boat voyage from Port Arthur around the whole northern shores of Lake Superior to Sault Ste. Marie. Besides these long and arduous explorations, Dr. Selwyn made many journeys and geological observations over large portions of every province of the Dominion, and as the foregoing record shows he was actively and continuously engaged in geological work for forty-seven years.

Dr. Selwyn, as Director of Geological Surveys, on behalf of the

Government of Victoria, Australia, and later of the Dominion, took a prominent and active part in the collection and preparation of the mineral exhibits at six International Exhibitions: Melbourne-Dublin, 1854-55; Melbourne-London, 1861-2; Melbourne-Paris, 1878; London, 1886. From all these exhibitions he was awarded gold, silver and bronze medals and diplomas. At the Paris Exhibition in 1878 he was elected Chairman of the Jury on Cartography, and was awarded the Cross of the Legion of Honor, and in London in 1886 that of the Order of St. Michael and St. George.

Since 1869 he edited and contributed to sixteen volumes of reports with numerous maps and illustrations relating to the structural geology and to the mineral, vegetable and animal resources of the Dominion. He is also the author of the Canadian part of Stamford's "Compendium of Geology and Travel—North America," London, 1883. In 1881-2 he superintended the removal of the Geological Museum from Montreal, and its re-organization on a broader basis in Ottawa, where it now embraces natural history, as well as mineralogy and geology, and has become the most complete existing collection illustrating the natural resources of Canada.

Nor is it only on the other side of the Atlantic that Dr. Selwyn's abilities have met their just appreciation. Both in the United States and Canada his work is held in high esteem. A leading scientist in New York has said of the maps published by him that they are "truly magnificent; my highest expectations are more than realized in them; they are, indeed, models of method and precision, and the most noble monuments to their originator." Another gentleman in a high position in the Lower Provinces said: "It is my unbounded appreciation of what has hitherto been done by the corps of the Geological Survey, under the directorship of an able and eminent chief of whom Canada may well feel proud, which prompts me to suggest and impels me to advocate the expenditure of a few tenths of a cent more apiece, to enable the Survey to continue recording and establishing in the most satisfactory manner, work that is being well done, and which ensures the industrial development of the country, while it will be at the same time a source of honest national pride when we compare our record with that of other countries." Many other encomiums might be cited did space permit, but sufficient has been said to show that Dr. Selwyn's worth was widely known and honored in the scientific world.

Last year the mining men of the country, through the Canadian Mining Institute, presented to the Geological Survey an excellent memorial portrait of Dr. Selwyn, as an appreciation of his work and the great services he has rendered towards the development of the mineral wealth of the Dominion.

CANADIAN MINING INSTITUTE.

The following communications have been received by the Secretary *re* discussion of papers read before the Institute:—

Mine Timbering by the Square Set System at Rossland, B.C.

Mr. ERNEST WOAKES, Nelson—I have read with much interest Mr. Bernard MacDonald's paper on the square set system of timbering used at the Le Roi mine and I should like to hear from that gentleman how he would have adapted his system to the peculiar conditions which existed at the Darien Gold Mines in the Republic of Colombia, South America, a mine of which the writer had charge some years ago.

In Vol. XXIX of the Transactions of the American Institute of Mining Engineers the above mine is fully described. The ore body may be roughly described as having the form of an irregular quadrilateral measuring 90 feet wide from north to south, and 120 feet long from east to west, and standing nearly perpendicular. The country rock was a decomposed andesite having many cleavage planes so that it was very liable to break up and cave if left unsupported. The ore body was composed of boulders and rock fragments from the adjoining country rock varying in size from pieces as small as a walnut to masses of many tons weight. These fragments are generally completely angular partaking of a breccia-like formation but at times they were rounded and resembled a conglomerate. The rock fragments are completely surrounded and cemented together by concentric shells of crystalline sulphurets and calcite with a little quartz. The gold was mostly free and was found almost entirely in the cementing materials. The ore was very high grade.

Timber was fairly plentiful but as in most tropical countries the majority of it was of very poor quality. It commences to decompose almost as soon as cut and for all underground purposes cannot be relied upon for much over twelve months. The square set system was introduced and practical men from Nevada were engaged to teach the natives how to prepare and set up the sets. Round timbers were used for the posts and nothing under 18 inches diameter was put in. The caps were flattened by adzing on two sides and the ties were of sawn lumber 8 x 10 inches. Great care was taken in setting the sills in each level, they were set north and south, east and west, with the idea of making sure that the uppermost tiers in one stope would eventually correspond as nearly as possible with the sill sets of the stope above. It was also found useful at times in the mine to know the exact bearing by means of the timbers. Very soon after starting stoping it was found to be necessary to keep the sets close up to the stoping faces or falls would occur. The conditions were much aggravated in the upper levels by the presence of old workings. Finally, after the whole width of the ore body had been stoped and the sets carried up from four to six sets high, it was found that the ore body was commencing to settle and the whole weight was on the timbers. Falls and caves became more frequent and finally a cave started above the upper floor and kept breaking away upwards to such an extent that it could not be caught up and eventually the whole stope crushed in, the timbers being forced out of plumb as the weight on them increased. False sets and diagonal braces were put in to resist the pressure but this was of only temporary assistance. After the cave a tunnel was driven in the country rock round three sides of the ore deposit and crosscuts driven in from it and the ore extracted as it ran down, temporary sets being put in where necessary, in this way the ore was taken out until surface rock and tree stumps began to shew in the stopes. In the deeper levels it was decided to try a different system. The square sets were put in as before but were only carried three or four sets wide all round the ore deposit leaving a large square pillar in the centre which was taken out as far as was possible after the greater part of the ore body had been removed. Crosscuts were driven into the country rock from the various floors and the waste rock from these dumped into the stopes where the timber shewed the worst signs of squeezing. It was not deemed prudent to leave any ore in the stope as filling it being of such high grade that the loss would be very great. Besides, as is unfortunately so often the case, the mill was generally calling on the mine for ore. It was a very wet mine and the rainfall was excessive, viz.: 110 inches a year. For this reason it was not desirable to have large open workings at the surface liable to sudden flooding, as would have been the case if filling from the surface had been resorted to as is in the case with the Ymir mine in this country. I, of course, believe that in most cases where wide deposits have to be worked the square set system of timbering is the most satisfactory, if

the mine can stand the cost of it, and after the mines have attained a certain depth it will often be found to be the only one possible. Luckily for mine managers conditions such as above described are not likely to exist very often, and if they do exist in the upper levels, it is to be expected that the ground will get harder and less liable to cave as depth is attained.

Mr. BERNARD MacDONALD, Rossland—I have read Mr. Woakes' criticism on my paper, "Mine Timbering by the Square Set System" and also that gentlemen's excellent article in Vol. XXIX of the Transactions of the American Institute of Mining Engineers, describing the Darien Mine, with great interest. I am sure any one who gives himself the pleasure of reading Mr. Woakes' description of this mining property will find corroborative evidence of the proposition that "no two mines are exactly alike."

In replying to Mr. Woakes' criticism I do so with the full knowledge of the difficulty of prescribing for a patient, without first seeing him and studying the idiosyncrasies of the malady. Therefore, the method of stoping and timbering the ore bodies in the Darien Mine, which I would propose as best suited for the peculiar conditions existing there would be considered as given under existing circumstances.

As a general rule when an underground ore body is being mined, greater strains are exerted on the timbers by the pressure on the enclosing walls than from the overhanging ore. On this account, the method of extracting the ore body generally adopted is by stopes or steps running horizontally within the vein and along it over the various levels and the spaces thus exhausted are timbered by "floors" or square sets extending horizontally between the enclosing walls. This is the method described in my paper.

But it seems that the generally prevailing conditions in mining operations were quite reversed at the Darien Mine, where the greater strains came from the overhanging ore, instead of, as is usual, from the enclosing walls. This might, in a measure, have been suspected from Mr. Woakes' description of the physical characteristics of the ore and the nearly vertical dips of the enclosing walls.

I would meet these reversed conditions by reversing the usual methods, or I should say direction of the stoping and timbering, viz.: I would run the stopes or steps of the excavation vertically upward between the mine levels, instead of horizontally over them.

For example: in stoping out any block of ore developed between two levels, I would first run a raise vertically through it, making such raise wide enough to be timbered into two compartments by two square sets going up in it side by side. When completed, this raise would furnish means of ventilation and access for men and material to whatever part of the ore body the work of stoping might be going on. I would then run all the stopes vertically upwards around this raise, commencing at the lower level and finishing at the upper level, mining out just enough ore at a time to admit of one new set of timbers being placed in the evcavation. By this method all the ore, except the one stope being excavated, would be supported on a solid foundation of ore in place. In case lateral or vertical pressure would give the timber sets a tendency to swing or "jack knife" out of their true horizontal and vertical position, as would probably be the case, I would keep the skeleton frame work of the sets filled up with broken ore, until all the block between levels was broken down. This method of temporary filling locks up for the time being about two-thirds of the ore in the stopes. The swell in volume of the broken ore over that in place being only about one-third. However, the two-thirds used for temporary filling could be drawn off after the work of stoping was completed, so that except for the time being no more ore used in filling would be lost.

This method would, in my opinion, be best calculated to meet the conditions existing at the Darien Mine.

The Electrolytic Production of Metals with Special Reference to Copper and Nickel.

Mr. TITUS ULKE, Sault Ste. Marie—Permit me to thank you for your kindness in sending me copies of discussion relative to "The Electrolytic Production of Metals, with Special Reference to Copper and Nickel," which you published.

I have only recently returned here from a nine-weeks' trip, inspecting the copper mines and smelting works of British Columbia, Washington, California, Arizona, and Sonora, Mexico, and have therefore not had leisure to write you before.

As regards Mr. Koehler's reply to my last stricture, I need hardly call attention to the fact, *re* 1, that Dr. Schnabel's classification is logical, while Mr. Koehler's is not, his explanation to the contrary notwithstanding.

Re 3. Mr. Koehler is finally compelled to admit my stricture, viz., "that the chloride method has, to say the least, not yet attained commercially practical prominence," and that there are grave dfficulties in its way not encountered in the ordinary sulphate method of electrolytic refining.

Re 7. As the technical press and leading experts view my process with unqualified favor, and as the novel features thereof are covered by broad patents, or pending applications for same, I need not further discuss the merits of my process.

The printed discussion, I take it, has fully borne out the merits of my contention and friendly criticism of Mr. Koehler's interesting paper, which I could not well pass over without noting the few inaccuracies cited.

Safety Lamps and Colliery Explosions.

Mr. JAMES ASHWORTH, Chaddesden, England—In reply to the discussion on this paper in your journal of the 30th of September, I agree with most of the conclusions arrived at by Mr. Blakemore, of Montreal, and Mr. Hardie, of Lethbridge.

It is quite possible that the explosion at Fernie was initiated by the failure of a Clanny lamp, but it is *impossible* for an explosion within any safety lamp to "shatter" the lamp, and it is also impossible to even open the seam of a gauze by an explosion within the lamp if it has been made with any ordinary care. A lamp might fail and then be broken by a fall of roof, but even this is not of one of the likeliest of possibilities, because the point where an explosition originates is the one from which the destructive forces radiate, and is therefore the centre of compression, and no force passes over the lamp—it may in fact be said to be immersed in the force. Sometimes there is evidence of the "back lash" of the explosion when the vacuum resulting from condensation comes into play, and under this condition a lamp in a main road might be knocked about, but it would show that the force which smashed it was operating from the outside and not from the inside.

There cannot be a doubt in the minds of people who have seen fine coal dust ignite inside a safety lamp, that it will do so more readily than firedamp, and also that as the particles are so small as to pass through the mesh of the gauze, flame from the ignited or incandescent coal dust may be produced outside the gauze and be the cause of a disaster even without an explosion within the lamp.

Both Mr. Blakemore and Mr. Hardie recognise this risk as a valid and dangerous one, and about which we require more information.

Mr. Blakemore considers the use of benzolene in safety lamps as

a fatal drawback, but in this respect I must differ with him entirely. Benzolene or, as it is sometimes called in England, colzalene (also benzine in translations from the German) has been and is still very extensively used as an illuminant, and judging from a long experience with it, I can say that it may be applied with perfect safety in a safety lamp, if the lamp is properly constructed to burn a volatile oil or spirit. Lamps thus supplied are not quite so economical in the cost of lighting as when using paraffin, or oil mixtures, but it is cleaner, and gives a good illumination with the minimum of attention. The greatest danger arising from its use is in the filling of the lamps, and they ought not to be filled to a greater degree than the sponge or cotton wool will absorb. Then the lamp itself should be of the best construction, and in my paper I called attention to two distinct risks which are attached to the Wolf class of lamp, viz.: 1st, the double air admission, that is from below the flame as well as from above the flame,—this construction was proved by the English Mines Accidents Commission of 1886 to be a far from safe mode of feeding the flame with air, and confirmed the experiments previously made by M. Marsaut; 2ndly, the igniting apparatus, which if brought into use whilst the lamp is full of gas mixture will originate an explosion and propel the flame straight through the gauzes. Therefore, I say that benzolene may be a perfectly safe and an excellent illuminant, if applied under a safe cover.

For gas testing purposes, and if applied in lamps of the Gray type, it is one of the best and handiest means of testing for lower percentages than can possibly be detected by an oil flame. I enclose

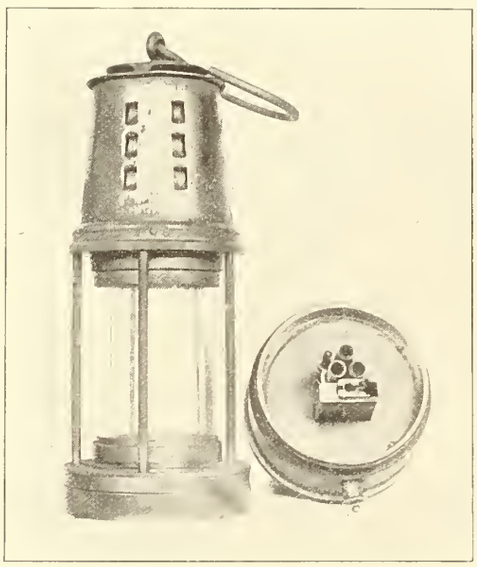


FIG. I.—Ashworth's patent tri-wick safety lamp, for burning petroleum spirit, and fitted with the Wolf patent relighter.—Illumination equal to 1⅛ standard sperm candles.

you a photo of one of my Gray oil vessels constructed to use benzolene and fitted with a Wolf igniter, for the use of firemen and examiners, Fig. 1.

Mr. Hardie's remarks are also an extremely interesting chemical review of the dangers arising from mixtures of coal dust and firedamp, and are worthy of the closest attention. He says that he most carefully examined the East mine of the South West Virginia Improvement Co. to find traces of firedamp, but he does not say what lamp he used. This point is of the first importance because he goes on to prove that the lamps in use, and as used by men in general, will not indicate much less, if any, than three per cent. His report after examining the same mine with the Ashworth-Gray type, using alcohol as the testing flame, or with the hydrogen gas test introduced by Dr. Clowes and myself, Fig. 2, would be very valuable for comparison.

With regard to the percentages of firedamp which safety lamps will detect, I may say that I purpose testing ordinary safety lamps in measured mixtures of gas and air, and in course of a few weeks I may be in a position to reply more directly to Mr. Hardie's enquiry as to

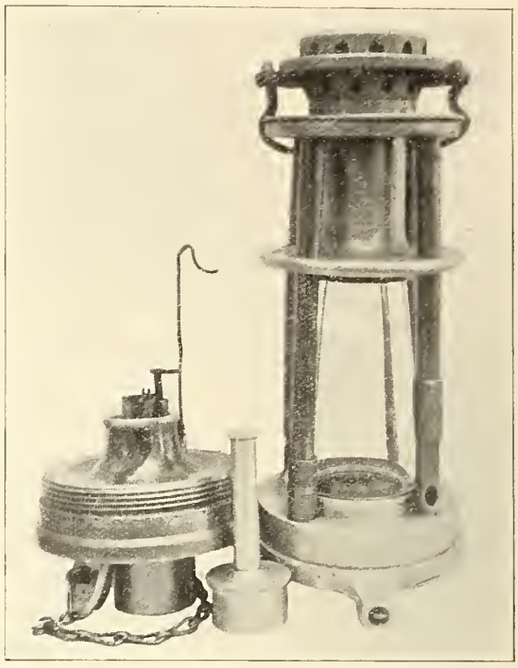


FIG. II.—Ashworth-Gray safety lamp with Ashworth, Clowes & Co.'s hydrogen gas-testing attachment.

the percentages represented by certain caps, but in the meantime I may make the following general statement:—

If ⅛ in. of "cap" is seen on a testing flame which is ⅛ in. high, and the total height of flame from the top of the wick tube is a full ¼ in., it would probably indicate 2½ per cent. of firedamp. In like manner a ¼ in. "cap" would, if of a total height of ⅜ in. above the top of the wick tube, indicate the presence of 3½ to 4 per cent. of firedamp, and a ½ in. "cap," with a total height above the top of the wick tube of ⅝ in. would indicate about 5 per cent. of firedamp.

To give a list of "cap" heights with corresponding percentages of firedamp applicable to all types of safety lamps is impossible, as the height of the "cap" is entirely ruled by the heat of the testing flame, its non-luminosity, and the surroundings of the flame. The truth of this will be rendered clear by a comparison of the "caps" produced

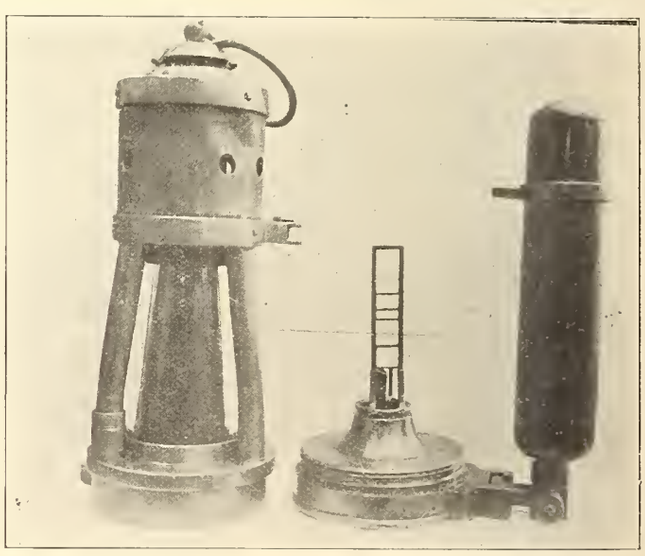


FIG. III.—Ashworth's Gray, with Stokes' alcohol spirit gas-testing attachment.

by oil and hydrogen flames of the same height; thus, supposing that the testing flames in both instances are a ¼ in. in height, and applied in the same type of safety lamp, the oil flame would produce a "cap" of $\frac{3}{10}$ in., whereas the hydrogen flame would give a "cap" of 1 in.

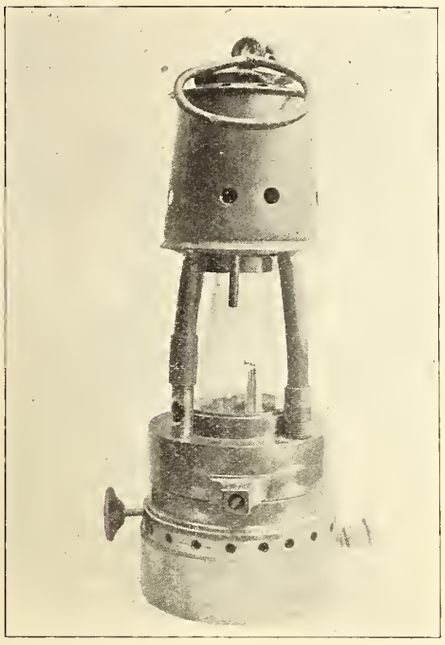


FIG. IV.—Ashworth-Gray with separate oil and alchol spirit gas-testing burners.

high. Alcohol and benzolene would give shorter "caps," but much more distinct than a colza-petroleum flame. For further proof of this rule, if we take the hydrogen flame and increase its height to $\frac{6}{10}$ in., we shall find that the "cap" for 1 per cent. of firedamp has become 3 in. high. Roughly stated, a colza-petroleum flame "cap" indicating 5 per cent. of firedamp is only equal in height to that produced by the hydrogen flame when indicating 1 per cent. of firedamp.

Having thus obtained some idea of the great divergence in the percentage of firedamp indicated by "caps" ⅛ in., $\frac{3}{16}$ in., ¼ in. and ½ in. in height, it is still necessary to ascertain which of these "caps" is dangerous, if indicated on the reduced flame of the lamps in use in

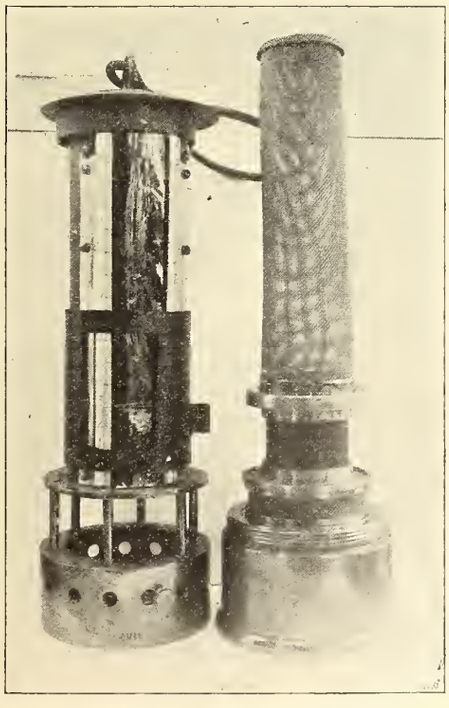


FIG. V.—G. Chesneau's alcohol spirit gas-testing lamp

the majority of the collieries; and for information on this point we may turn to the Mines Accident Report of 1886. In this report it is stated that neither the Davy nor the Clanny lamps will show 2 per cent. of firedamp, and therefore a "cap" of ⅛ in. high must indicate some percentage of firedamp in excess of 2 per cent. The Commissioners also reported that 2 per cent. of firedamp with the addition of a normal quantity (not a cloud) of coaldust is inflammable in the presence of an open light.

As probably many others besides Mr. Hardie are desirous of having all possible information on the point of danger when both coal dust and firedamp are factors, I may state from personal experience that the flame will pass out of a Davy lamp and explode the outer atmosphere, when the latter consists of a normal quantity of coal dust floating in an air current having a velocity of six feet per second, if 4½ per cent. of firedamp is added to the mixture. The life of a lamp under these conditions is only equal to 10 seconds purchase.

Mr. Hardie refers to the Clowes and Stokes safety lamps, and therefore I have added photographs of these lamps from which he and your members will see, without any added description, that both are what is known as the Ashworth's Hepplewhite Gray deputy lamps. The addition of the hydrogen test to this lamp was originally the Ashworth and Clowes patent, Fig. 2, and similarly the alcohol detachable arrangement is the Stokes patent, Fig. 3, and not the lamp.

As to the power of these lamps for detecting gas they are as follows:—(1) The Ashworth-Clowes hydrogen test; (2) the Ashworth, Fig. 4, Pieler, and Chesneau alcohol tests, Fig. 5, and (3) the Stokes alcohol test, Fig. 3. That is to say the capacity of a safety lamp to detect firedamp is due to the heat of the flame and its non-luminosity and the hydrogen therefore possesses the highest qualification.

I need scarcely say that I shall be glad to add to these notes when requested, or to correspond with any member in relation to safety lamps.

Mr. Kirby's Detailed Figures.

The detailed figures referred to and promised by Mr. Kirby as part of the discussion of his paper on "The Influence of Government upon Mining," have been furnished and are as follows:—

POPULATION OF BRITISH COLUMBIA.

The census of 1901 is not yet published. The estimate of the Provincial Government (see argument of Hon. James Dunsmuir in Report of Delegation to Ottawa) is 150,000, including 23,000 Indians and 15,000 Japanese and Chinese, and 112,000 whites. This is undoubtedly low and will probably be found near to 125,000 to 130,000 whites.

REVENUES CONTRIBUTED TO GOVERNMENT BY THIS POPULATION.

These are Dominion, Provincial and Municipal revenues.

Dominion Revenues.—From the "Report submitted to the Lieutenant-Governor by Hon. James Dunsmuir, Premier, and Hon. D. M. Eberts, Attorney-General, on their mission to Ottawa as a delegation from the Government of British Columbia," March 15th, 1901. This at much length calls the attention of the Dominion Government to the fact that the revenue contributed by British Columbia to the Dominion is excessive, and out of proportion to that furnished by other Provinces, and estimates its amount for 1901 at $3,750,000 from the aforesaid population.

Provincial Expenditure and Revenue:—

Expenditures (from "Estimates of Revenue and Expenditure for year ending June 30, 1902"), page 2	$2,475,335 00
Supplementary Estimate No. 1 (see separate sheet)	50,440 00
Supplementary Estimate No. 2 (see Estimates for year ending June 30, 1903) page 31	192,408 00
Total	$2,718,183 00

Revenues (from "Estimates of Revenue and Expenditure for year ending June 30th, 1902"), page 1		$2,140,751 co
Less Receipts from Dominion Government and land sales		539,151 co
Revenue to be contributed by Province		$1,601,600 co
Expected Expenditures	$2,718,183 00	
Expected Revenues	2,140,751 00	
Expected Deficiency to increase debt	$577,432 00	

This revenue contributed to the Dominion and Provincial Governments is far from being the entire amount taken out of this population for Governmental purposes. It is, however, the only portion for which figures are yet published. To it must be added local or municipal revenues amounting to a large but unknown aggregate, and the increased cost of supplies purchased in the Eastern Provinces due to the unnaturally high prices fixed by the tariff. While this is not a part of Government revenue, it is the accompanying result of the tariff tax and the same to the payer, British Columbia, as is shown by the Provincial Government in its argument to the Dominion Government,—Report of Delegation to Ottawa, March 15th, 1901. The additional cash which it takes out of the population can only be guessed at, but it is evidently a large sum.

SUMMARY.

Dominion Revenue	$3,750,000 00
Provincial Revenue	1,601,600 00
	$5,351,600 00
Local and Municipal Revenue	? ? ?
Tariff increase on Eastern supplies	? ? ?
Total cash taken out of population by Govt.	? ? ?

INDEBTEDNESS.

From the British Columbia Public Accounts for the year ending June 30, 1901, page 7, the Provincial debt funded and floating on that date is $9,619,482. The Public Accounts for the year ending June 30th, 1902, are not yet published, but as the increase between 1900 and June 30th, 1901, was $952,424, the total on June 30th, 1902, evidently exceeds $10,000,000.

PRODUCTION OF THE FIVE PRINCIPAL INDUSTRIES FOR 1901.

The first two are accurate. The others, for want of statistics, are approximate.

The Report of the Minister of Mines for year ending December 31, 1901, gives:—

Metal Mining	$15,070,382
Coal Mining	5,016,398

For the other three the only statistics so far published are those given in the 22nd Annual Report of the British Columbia Board of Trade, 1901:—

Fisheries.—Exports of Fisheries for 1901, page 65.		$2,665,915
From the proportion of total production to exports given for the salmon catch of 1900, page 57, the amount to be added for home consumption is roughly estimated as		400,000
Total product of Fisheries		$3,065,900
Lumbering.—From the same report, page 23:—		
The total timber cut on Crown lands, leaseholds, private property, is 223,374,723 feet, which at $7.50 is		$1,690,000
Agriculture and Stockraising.—From the same report, page 65, the exports of produce are as follows:—		
Animals and their produce	$170,218	
Agricultural products	231,544	
Miscellaneous	1,317 687	
	$1,719,449	
To which is added 50 per cent. to cover the value of the product of this industry consumed locally		800,000
Probable production		$2,520 000

EXPLANATORY REMARKS.

These statistics merely bring to a later date those of the British Columbia Mining Association in their Memorial to the Governor-General in Council, June 28th, 1901. The figures of the taxation load speak for themselves, but following their method of presentation a comparison is made between the revenue taken for government and the production of the five principal or basic industries. Since the only object is to illustrate its size, it may of course be compared with anything desired. The five basic industries are selected as the most interesting and useful basis. It is of course impossible to compare with the total production of economic wealth by all occupations, because this is unknown and if known would be less useful.

These basic occupations support practically all the others. So that the population may be roughly divided into five portions, each of which includes those dependent directly or indirectly upon one of these basic occupations, and therefore conveniently classed as a part of that industry. The mining industry, for instance, is taken to mean that portion of the population with all its minor occupations which would disappear if all the mines suddenly vanished. The comparison made is between the Government revenues extracted from that portion and the mine production which sustains it.

[NOTE BY EDITOR.—The 1901 Census figures, since published are as follows:—

Whites	132,483
Indians	25,593
Chinese	14,689
Japanese	4,507
Total population	177,272

Objects to Mr. Kirby's Paper.

To the Editor:—Having just finished reading a criticism of Mr. Kirby's paper read at the Nelson Institute meeting, allow me space to comment on same, as one interested in British Columbia mining matters.

If such a misleading and utterly unreliable paper as Mr. Kirby's is published as one of the papers of the Institute, the really valuable papers which have so far been well received will lose interest for readers who desire to obtain facts and are not looking for political fictions to the very serious detriment of the Institute. The criticism in your October number mentions "increasing paralysis" of the industry in this Province and no further notice is taken of that utterly untrue statement. The facts are that the preceding year saw an increase of copper-gold smelting facilities alone of something like one thousand tons daily all of which is fully employed. An increased copper production equal to 175 per cent. An increased gold production from lode mining alone) equal to 26 per cent. An increased silver production equal to 25 per cent Lead alone showing a decreased production of 25½ per cent, due entirely to United States politics and *not* as Mr. Kirby states to Canadian Government tactics in smallest degree. If this large increase in the earnings of the mining industry denotes an "increasing paralysis" please allow the "paralysis" to continue indefinitely. The only serious troubles in connection with the mining industry, outside the lead district, in this Province of British Columbia are (or were, having disappeared there also at this time) confined to Rossland Mining District and were caused by over-capitalization, booming, and especially, by attempted unfair treatment of the miners in the endeavor to make dividends for the over-capitalized Rossland mines, undertaken by a few men of whom Mr. Edmund Kirby was certainly one. It is most unfair and against the interests of all legitimate mining in the mining Province of this Dominion that such statements should be made at all, and worse if they are allowed under any circumstances to appear as being the views of the Canadian Mining Institute members, who were represented at that meeting by a small number drawn from the disaffected districts in large majority. If the paper is allowed to appear it should have a rider attached as "being the views of the Rossland Camp alone and utterly repudiated by the rest of British Columbia." I enclose my card.

A MEMBER OF CANADIAN MINING INSTITUTE.

Vancouver, B.C., 15th Nov., 1902.

A Dry Process for the Treatment of Complex Sulphide Ores.*

By H. Livingstone Sulman and Hugh Kirkpatrick Picard.

The class of ores to which our process is applicable is that in which zinc blende and galena predominate, substantial silver values being also generally present; these, commonly known as "complex sulphide ores," are typified by the Broken Hill deposits. The latter indeed are of unusually refractory character, the metallurgical difficulties attending the separation of the lead and zinc being increased by the intimate intercrystallisation of the minerals as well as by the presence of ferrous sulphides, garnet, rhodonite, etc., in considerable quantity.

It is unnecessary to review at length the many attempts to treat these ores, the more important later efforts being well known to members of this Institution; and much valuable information as to the types and values of the Broken Hill deposits is to be found in Mr. Ashcroft's paper.†

Before entering into the details of our process it is advisable to briefly indicate the methods at present employed for recovering the major values from such ores. They are all comprised under the head of concentration, the usual various types of apparatus, both wet and magnetic, being employed. Concentration, indeed, has here been carried to a state of high perfection, but however ingeniously applied, it cannot, owing to intercrystallisation and the slight differences in gravity between several of the minerals, obtain sharply demarcated products; hence it can never be more than partially successful. Even supposing the bulk of the galena to be capable of close separation, a large proportion of the silver would still follow the blende, and thus be lost in the subsequent treatment of this mineral for the commercial production of spelter.

Present systems consist therefore in the mechanical separation of the largest yield of galena which shall carry only such blende as is incapable of giving rise to serious smelting trouble. These lead (silver) concentrates are smelted in the usual manner, and constitute the only product of commercial value derivable from the ore. The other bye-products are zinc middlings, siliceous tails, and slimes; each is more or less contaminated with all the various minerals of the original ore. Thus, whilst the galena concentrates carries several per cent. of zinc, the zinc middlings similiarly hold large amounts of lead and silver, but are nevertheless of little or no present value; samples which have come before us have averaged 25 to 27 p.c. of zinc, about 12 p.c. of lead, and 10 to 12 oz. of silver. The slimes are more or less representative of the whole ore-bulk, and may even be somewhat enriched in zinc and silver; large parcels dealt with by us have been as high as zinc, 25 p.c., lead, 24 p.c., silver, 26 oz.; but the general run is lower, say, zinc, 20 to 22 p.c., lead, 17 to 19 p.c., and silver 15 to 18 oz. per ton. Slimes are also at present practically valueless. Chairmen of the various mines are apt to describe these middlings and slimes as a reproach to the metallurgist, and to picture to their shareholders visions of the potential wealth which these huge accumulations represent, realisable when once the process for their successful reduction shall be discovered.

At the various Broken Hill mines reduction work is now limited to concentration, the leady concentrates being shipped to coastal smelting works, where they are reduced to bullion with other purchased ores. Nett recoveries do not probably exceed 60 to 75 p.c. of the lead, and 55 to 65 p.c. of the silver; with the exception of small parcels shipped to Europe periodically, no zinc is recovered, though on this point it is difficult to obtain figures.

The economics of the problem have not greatly altered from those outlined by Mr. Ashcroft in 1898, when he showed that, with the then metal prices, a profit of 15s. was all that was realisable from an ore value of some £9 per ton. Since that date it is true that considerable fluctuations in prices have occurred; zinc rose to £28, but though this was a useless boon to Broken Hill, lead appreciated to £16, and for a while permitted of good dividends. This period was shortly succeeded by a still more serious fall, lead receding to a lower level in 1901 than had been known for many years, whilst silver has recently touched its lowest recorded price. Indeed in 1901 all the Broken Hill mines with the exception of the Proprietary and Central Companies were for a while shut down. Although both lead and zinc have exhibited a slow rise of late months, the general outlook cannot be considered much brighter than Mr. Ashcroft had to face in 1898. Nor do the ore supplies show any tendency to increase in value. An average of 17 p.c. lead, 24 p.c. zinc, and 13 oz. of silver per ton may now be regarded as a general type of available material.

The greatest advances of late have been in the direction of magnetic separation; various types of magnetic concentrators are now under trial and in use at the different mines, by which a closer saving is possible, and the further concentration of the middlings into what may be considered as a very inferior type of zinc blende ore can be effected. The inferiority of these zinc concentrates lies in the continued presence of considerable percentages of lead, and frequently of as much as one-third the silver originally held by the ore.

By one type of magnetic concentrator known to us the galena and quartz are obtained together, a more or less impure blende as the second product, and the bulk of the rhodonite in a third; the lead product then undergoes wet dressing to separate the silica. Starting with 100 tons of ore, about 40 tons of blende product are obtainable, assaying 40 to 45 p.c. of zinc (about 70 to 75 p.c. of the total in the ore), about 7 p.c. of lead, and from 10 to 12 oz. of silver. This product is bought in limited quantities by European smelters, but we are unable to say whether they pay for the silver or exact a fine for the lead. In this country nothing would be paid for the silver, and it is doubtful if the English zinc smelter would under any circumstances treat an ore containing 7 p.c. of lead. It is probable that on the Continent this product is mixed with pure blende ore in order to reduce the lead to a possible smelting charge. 16 to 20 tons of galena concentrates are produced after water dressing, the first product containing about 75 p.c. of the original lead and 45 to 50 p.c. of the silver. The lead product is of course subject to the usual smelting losses, which may vary from 7 to 10 p.c.

A second system, investigated rather with the idea of obtaining the richest mixed galena-blende product for our own use than with the object of effecting the sharpest possible separation of each mineral, was able to produce from zinc middlings (assaying 30 p.c. zinc, 8½ p.c. lead, and 12 oz. silver) a mixed concentrate amounting to 65 p.c. of the original ore weight, and carrying 39 p.c. of zinc, 11½ p.c. of lead, and 14½ oz. of silver; equal to total recoveries of 85½, 87, and 81 p.c. respectively. This was obtained by the mixing of a more with a less leady concentrate.

The foregoing is a brief sketch of the recoveries now obtainable in Australia, and given to indicate the possible scope of inventions for remedying the unsatisfactory results realised even by the best systems of concentration.

In the cases of the many huge deposits of complex ore known to exist in other localities, but hitherto unworked, present Australian methods would not necessarily be followed as preliminary steps in our own or perhaps other processes. The Broken Hill products and accumulations are the outcome of evolutionary concentration methods; but in many instances complex ores are capable of direct reduction without the need of mechanical separation, or at most but that of barren silicious gangue if desirable.

*From the Transactions of the Institution of Mining and Metallurgy.
†Transactions, Vol. VI, p. 282.

In our search for a suitable reduction scheme we desired to confine our attention to dry processes in order to avoid the apparently insuperable difficulties attendant upon all wet methods. When it is remembered that the weekly production of ore from Broken Hill mines amounts to some 20,000 tons, and that the maximum density of zinc sulphate liquors practically allowable cannot reach much over 20 p.c., the task of dealing with the huge necessary bulks of solution, and of leaching, filtration, concentration, and precipitation, operations on such becomes appalling. Even then (electrolysis being as yet unsuccessful with aqueous zinc solutions) the result is only a product requiring dry distillation. Indeed, it becomes evident that the difficulties of wet recovery processes only really commence when the solution of zinc or other metal has been effected.

Dry processes are of course no novelty, as witness the efforts of the Smelting Corporation, of Ellershausen, Armstrong, Angel, Claus, and many others in this direction. But we believe we are correct in saying that hitherto all dry processes have started with the intention of recovering the lead and silver in the first instance, whilst obtaining the zinc as a volatilization, or as a slag, or other residual product, for subsequent re-treatment. We cannot, however, include in this catagory the recently introduced Phœnix process, which, if alone from the daring ingenuity displayed, is worthy of a class to itself.

In fact, zinc has always been considered as the objectionable element in the ore, and the efforts of inventors have almost invariably been towards its early elimination, with the hope, never yet realised, of a subsequent economic recovery. The reasons for this attitude are easy to discern ; these ores have always been considered primarily as *lead* ores, whilst those interested in the zinc industry, who may have directed attention towards such, have condemned them at once as unsuitable for treatment in zinc retort furnaces, owing to the fatal presence of lead in any product obtainable by dressing.

The difficulties in distilling leady zinc ores are shortly these. Foremost comes the destruction of the retorts by the reduced lead ; this occurring mainly during the stirring out of the seconds from the pots whereby the metallic lead is oxidised to litharge, with the inevitable result of the rapid slagging up and holing of the retorts. Even could this be overcome, it is found in ordinary practice that lead tends to volatilise with the metallic zinc vapours in such quantities as to materially damage the spelter produced. Finally, if lead were capable of complete elimination from the ore, we should still have the question of the silver to deal with, which, as we have shown, largely follows the blende, and would, in the usual routine, be lost both in the seconds and (similar to the lead) by partial volatilisation in zinc vapours.

We may point out that gold also escapes under such conditions, and it was in regard to the recovery of this metal from zinc precipitates obtained from the cyanide process that we were led to devise a method for obviating such losses.* Indeed, the success of this method induced us to further apply the same principles to the treatment of complex sulphide ores. Our idea was therefore to treat these primarily as *zinc* rather than as *lead* ores ; and to obviate the difficulties encountered when the material is so considered.

It is necessary to draw particular attention to the rule invariably adhered to in zinc smelting, viz.:—To employ nothing except anthracite as mixing coal ; it being supposed that the gases resulting from the carbonisation of other classes of fuel cause losses in spelter. Moreover, other fuels are (reasonably) considered likely to lead to the slagging of retorts during distillation,† a danger to be avoided as far as possible ; even good (roasted) blende ores always contain much slag material (Fe_2O_3, FeS, SiO_2, etc.), whose baneful influence it is sought to reduce to a minimum by the addition of a very large excess of coal over and above that required for reduction purposes ; such excess acting as a mechanical diluent. As the amount of mixing coal used in general practice varies from 50 to 100 p.c. (on the roasted ore), it is essential that this should contain the least possible ash. Further, slagging troubles would be far more pronounced if an ordinary zinc distillation of roasted Broken Hill ore were attempted ; as, apart from the lead and ferrous sulphides, we have also the maganous oxide, which yields a very fluid slag with silica, and much garnet. As the result, however, of our experience in the distillation of zinc-gold material, we formed the opinion that the use of a strongly coking coal would, by holding dangerous materials suspended in its pores, overcome the objections to the presence of lead and other slag formers, and permit of the distillation of complex blende-galena ores as ordinary spelter-yielding material. In this factor alone has lain our main departure from previous methods, and extended practical trials have proved our anticipations correct. It is unnecessary here to further trace our progressive trials, and we now consider the completed process.

It commences with the usual preliminary roast of the crushed ore, slimes, or zinc-lead concentrate, in a reverberatory furnace, to a product which shall contain, preferably, not more than 3 p.c. of total residual sulphur.

The roasted ore is next mixed with only about 20 p.c. of crushed *coking* coal, and the mixture briquetted in any suitable type of machine. As a binding agent pitch, or other carbonaceous material, is added ; lime or other chemical binders are undesirable as they tend to permeate the whole briquette with slagging material, and also, from some unexplained reason, to cause lead losses. Further, the admixture of a carbonaceous bond aids the bituminous coal in forming the cohorent coke which not only the distillation but the subsequent lead-smelting operations demand. The briquetting plant is of a standard type consisting of a disintegrator, into which the roasted ore, coking coal, and pitch, are introduced, a pug-mill, press and table, together with the usual intermediate elevators and a conveyor belt for delivering the finished briquettes to the retort house.

The briquettes are then submitted to distillation in an ordinary zinc retort-furnace. Those used by us at the Emu works in South Wales are of the old-fashioned hand-fired Welsh-Belgian pattern, without regenerators, and using hand-made pots. Each contains 144 retorts in 6 rows, the lowest being cannon pots ; a retort takes about 15 briquettes, the total capacity of a furnace being seven tons.

This type of furnace is, nevertheless, not the most suitable for our requirements, as six rows of retorts one above the other cannot be uniformly heated by bottom firing. The lower row of cannons is apt to be damaged by excessive heat if the uppermost rows are to receive an adequate temperature ; too sharp a heat is also detrimental to the best extraction. In most spelter works employing this type of furnace the difficulty is avoided by using the lower rows for the distillation of "hard" material (roasted blende), whilst the upper are employed for "soft" (calamine) ores. On uniform material such as we treat a compromise must be effected ; we therefore work to obtain the best results from the three intermediate rows. These give us a 70 p.c. zinc recovery on 26 p c. briquetted ore, whilst the lower and upper rows yield a few per cent. less.

For these reasons the gas-fired 3-row type of furnace has been adopted for our process at Cockle Creek, as it permits of absolute uniformity of heating, and, therefore, of the maximum recovery. Hydraulic-pressed retorts, so universally used on the Continent and in America, are also employed in Australia. In ordinary zinc-smelting practice the roasted ore and anthracite duff are hand-mixed in front of each furnace, the damped power being then charged into the retort ; by our method the mixing is more efficiently performed in the briquetting

*See Journ. Soc. Chem. Ind. xvi p. 967, also Trans. Inst. Min. Eng., March 20th, 1898.

†Louis and Schnabel II. 89.

plant, and the charging of the briquettes more easily effected by means of a shaped iron paddle.

Once charged, the procedure for the recovery of the zinc is identical with ordinary practice, although the action within the retort is of a different character. The briquettes, as they reach the temperature of distillation of coal, coke into coherent masses, with evolution of volatile hydro carbons. Reduction of the lead simultaneously occurs, the minute metallic particles entirely premeating, and being held up in the pores of the coke; whilst, at the higher temperature shortly afterwards reached, zinc oxide is reduced, and yields metallic zinc vapours, which are condensed in pipes; these are tapped at intervals in the ordinary way. The distillation occupies the normal time.

We draw attention to the remarkable fact first noticed at the outset of our experiments, now confirmed by some years' experience, that, whereas in ordinary practice lead distils to a marked extent in zinc vapour, in our process the whole of the lead, as also the silver and gold, is retained by the coke. The latter thus appears to exert an actual physical retardation of the volatility of lead in a slow current of zinc vapour. So definite is this advantage, that we find the spelter thus produced from Broken Hill ores to be of exceptional purity; averaging 99 p.c. of metallic zinc, and commanding prices equal to that of the best brands produced from lead-free ores. This spelter is already in considerable demand, owing to its low lead tenour, which does not often exceed ½ p.c.; it can thus be employed for the manufacture of the finer kinds of brass, for which the ordinary brands, containing from 1 to 2½ p.c. of lead, are useless.

The zinc having been recovered, the seconds are withdrawn from the pots (pipes and luting clay having been removed, and sweeps collected) and discharged into the caves, whence in usual practice they would be dumped. But, the seconds resulting from the treatment of such complex sulphides ores still retain the major values, in the shape of all the lead and silver originally present. These are obtained in the coked briquettes in a form eminently adapted for recovery in the subsequent lead smelt. The zinc retained in the seconds does not exceed the amount allowable in ordinary practice, and presents no difficulty in obtaining of the usual bullion recoveries. The residual carbon in the seconds is, of course, a considerable source of heat in the after-smelt, and is therefore not lost, as it is in the case of ordinary zinc seconds.

By this simple operation we are enabled to convert a complex ore into a simple silver-lead product, amenable to normal reduction methods, having already recovered the bulk of the hitherto objectionable zinc as high quality spelter. The final operation for the recovery of lead and silver as base bullion being the ordinary one, conducted in the usual types of plant, both in South Wales and Australia, does not call for further description here.

Indeed, we may remark that the few operations which constitute our process are all effected in well-known and standard types of plant; and that no fresh item of apparatus, concerning which there might be doubt as to costs or method of working, has been found necessary. Roasting, briquetting, zinc-distilling and lead-smelting methods and costs are fully known. Throughout the operations, nothing beyond coal and binding agent and the usual lead-smelting fluxes are employed. It is somewhat surprising that so simple a method of treatment has been so long overlooked. The system is compact, and permits of economies when zinc and lead-smelting processes are thus linked together, not realisable by either separately.

In general, blende ores containing less than 40 p.c. of zinc are not profitable to treat. Such if mixed with 80 p.c. of anthracite duff would yield pot material containing little more than 22 p.c. of zinc; whereas a zinc-lead concentrate, containing say 35 p.c of zinc, requires, by our process, the addition of only 25 p.c. of mixing coal and binding material, and produces a briquette carrying 28 p.c. of zinc; with the additional advantage of yielding a residue containing profitable material. It is possible to treat a 35 p. c. concentrate for its zinc alone, the lead and silver remaining in the residues as profits subject only to recovery costs; whilst the fuel values remaining aid in reducing these.

Recoveries.—Lead, silver, and gold, as before stated, are recovered in the seconds in full; the lead of course is subject to the normal smelting losses, just as in the treatment of ordinary lead concentrates; though the Huntingdon and Heberlein, and Carmichael, processes, claim to reduce such losses to about 2 p.c.; and we believe these claims to be well founded.

Bearing in mind the fact that the seconds hold all the lead in the *metallic* condition, the question naturally arose as to whether smelting was the most economical method of recovering this metal and the silver. We devoted considerable attention to the mechanical separation of the reduced lead, but unsuccessfully. The metallic particles and prills are so exceedingly finely divided throughout the carbonaceous sponge that any method of water dressing or concentration results in heavy loss; nor did oil concentration give any better results, owing to the excessive amount of carbon also taken up. On the whole, smelting was adopted as the simplest, safest, and most usual method.

With regard to zinc recovery, the spelter yields are practically the same as those obtained in the ordinary treatment of blende ores. To reckon in percentages is somewhat illusory, as these depend naturally upon the original zinc contents of the ores treated. With a zinc-lead product carrying 40 p c. of zinc no difficulty is experienced in obtaining a recovery of 80 p.c. of that amount, whilst, with a 25 p.c. material, 70 p c. may safely be reckoned upon in modern furnaces. Late advices from Cockle Creek inform us that the recoveries of both lead and silver in the seconds are complete, and that the zinc production already exceeds 70 p.c.; Slimes averaging 25 p.c. of zinc being the raw material used. With 35 p.c. material we have every reason to anticipate an 80 p c. recovery. The pot consumption is quite normal there; mixing coal is obtainable at lower rates than are available to us in South Wales. Fireclay of good quality for the manufacture of hydraulic pressed retorts is also available on the spot; and we have used trial lots of this material for some of our retorts in South Wales, with excellent results. The works at Cockle Creek are the first producers of spelter yet installed in Australia.

In ordinary zinc practice, it is not found economical to force the extraction below a certain point, as the increased time required not only reduces the output of the furnace, but, with the higher temperature necessary, the pot censumption becomes unduly great. The zinc usually left in the seconds varies from about 5 p.c. to 8 p.c. Our working costs are also normal; no difficulty is experienced in calcining the complex ores to the sulphur standard usually required for blende; the zinc furnaces do not demand any greater attention or further hands, whilst labour in retort charging and discharging is materially lightened by the use of briquetted material. Briquetting charges are, of course, additional; but are to some extent balanced by the far smaller consumption of mixing coal, and by the economical handling of material during the final lead smelt.

A point to which attention will doubtless be directed is that of pot and pipe consumption. The average life of our pots, even though used for distilling such highly refractory material, is fully equal to that of the retorts used for good blende and calamine ores according to usual methods, being from five to six weeks each. Our present consumption per day is 3.7 pots per furnace. The cost of our hand-made pots is about 6s. apiece. This is admittedly high, even for England, and hydraulic-pressed retorts, having a longer life, requiring less clay, and demanding a lesser distillation temperature, can be produced for 3s. each.

A certain proportion of "fines" is inevitably produced in raking the briquette seconds from the pots into the caves beneath the furnace house. These are separated, damped with water, and rebriquetted for lead-smelting purposes from time to time at a cost of about 2s. per ton of fines.

We append a schedule of cost incurred during the late treatment of a parcel of Broken Hill slimes, averaging 25 p.c. of zinc, 24 p.c. of lead and 26 oz. of silver per ton.

Calcining.—Hand roasting of such material to 3 p.c. of total sulphur or slightly under in South Wales costs about 9s. per ton, whilst mechanical roasting in the Godfrey furnace amounts to about 6s. 6d. Other forms of mechanical calciners, such as the Brown Straight Line, will roast complex sulphide ores to this limit at even lower cost; but at present the hand-calciner and the Godfrey appear to yield the denser product and also to be preferable in other respects. The question of the best form of calciner is not fully settled, but we select the Godfrey costs as those most lately obtained.

COSTS PER TON OF ORE TREATED.

	s. d.	s. d.	s. d.
Ore drying.—Screening and crushing of lumps, and wheeling....			2 6
Calcining.—Fuel, labour, maintenance..			7 0
Briquetting.—(30 tons of roasted ore per day)—			
Labour.—1 pressman at.....	5 0		
3 belt men "..... ...	5 0		
2 labourers ".....	3 9		
Boilerman ".....	4 9		
		32 3	
Coal.—			
1 ton for boiler.....		8 6	
6 tons for mixing, at 8s. 6d...		51 0	
Pitch.—1½ tons at 45s.....		72 6	
Stores.—Oil, etc.....		1 3	
Cost of briquetting 30 tons =		165 6	
= per ton ore			5 6¼
Retorting.—(Costs per furnace per 24 hours),			
Labour.—2 foremen at 6s. 8d. =	13 4		
2 second hands at 5s. 6d..... =	11 0		
2 helpers at 4s. 3d... =	8 6		
4 cave men at 4s. 3d. =	17 0		
1 pipe chipper (boy)....	1 4		
General labour	5 9		
		56 11	
Pottery.—3.7 pots at 6s. ..... =		22 3	
9 pipes at 2d..... =		1 6	
Coal, for firing 3¼ tons at 9s.6d. =		30 10	
Stores, luting clay and repairs....		4 6	
		116 0	
Contingencies, unoccupied pots, dead-fires, etc., add 5 p.c... =		5 9½	
		121 9½	
For charge of 7 ton briquettes = 5·6 tons of ore = per ton..			21 9
Yard and general labour			1 6
Re-briquetting of "fines," at 2s. per ton—			
Seconds contain 30 p.c. fines; on 80 p.c. of seconds..... =			5¾
Smelting costs on seconds (see p. 12).—			
(Seconds amount to about 80 p.c. on the original ore.)			
Smelting per ton seconds.....	12 6		
Refining, sales, brokerage, insurance, etc., at £2 per ton of Bullion produced, at 26 p.c. bullion	10 5		
Per ton of seconds		22 11	
= per ton ore.....			18 4
Lead smelting losses—			
2.8 units of lead (= 10 p.c. on residues) at 2s. 3d.....			6 4
5 p.c. silver = 1¼ oz. at 2s. 1d.			2 8
Office management and assays—dependent on size of installation, say			5 0
Total cost of treating 1 ton of ore			71 1
Recoveries—			
Zinc, 70 p.c. (of 25 p.c.) = 17·5 units at 3·65s. =			63 10½
Lead, 90 p c. (of 24 p.c.) = 21.6 " 2s. 3d. =			48 7¼
Silver, 95 p.c (of 26 oz.) = 24·7 oz. at 2s. 1d. =			51 5½
			163 11¼
Less costs			71 1
Realisations.....			£4 12 10¼

From which must be deducted cost of transport of slimes or cost per ton of ore.

In regard to the first four items the above costs are certainly capable of reduction.

In South Wales we have at present no lead-smelting plant for spot recovery of the seconds values, but dispose of these to local reduction works according to their assay values upon the usual scale of returning charges. The erection of lead-smelting plant at our own works is under consideration, in order to save these extraneous profits and to obviate freight to the smelters. In Australia, the smelting plant is that in ordinary use for reduction of the lead concentrates, etc.

The work outlined has occupied our attention for some years past, during which we have carried through a large number of experiments in the laboratory, in small works specially erected in Surrey, and finally at the Emu Works in South Wales, where large scale furnaces have been running for the past year as a commercial undertaking. We have there treated over four thousand tons of Broken Hill slimes besides many other parcels of complex sulphide ores. The recoveries of lead and silver have been practically complete in all cases, whilst the spelter yields have varied from 60 p.c. to 80 p.c., according to the original zinc contents.

Complex ores containing copper present no further difficulties as to retort treatment; the copper, of course, remains with the lead and silver in the seconds, and is thence obtainable by modern copper-lead smelting methods.

Summarising our process, it may be said to consist in the holding up of the minute particles and prills of reduced silver-lead in a coherent but still highly porous coke or carbonaceous sponge during zinc distillation; thus preserving the retorts from contact with lead or other slag material, and ensuring the all but complete non-volatility of the lead and silver in the liberated vapours of metallic zinc.

In spite of its apparent simplicity, our process has been found capable of complete patent protection in the principal countries and colonies of the world; whilst the grant to the United States, German and Scandinavian patents, may be taken as evidence of novelty.

Gold Dredges—Their Construction and Manipulation.*

By DAVID K. BLAIR, Consulting Dredging Engineer.

In this paper it is not the intention to traverse gold dredging from its elementary stages, or to deal to any extent with its aspects historically—this has already been done by various authors—but simply to give as concisely as possible, in the limited time at our disposal, a description of the "Bucket Gold Dredge" as we find her at the present moment, and the general principles of her construction and manipulation, the accidents to which the various parts are liable, with their cause, effect, and remedy; avoiding, as much as possible, technicalities of a bewildering nature.

To many the idea of dredging suggests the necessity of a river, lake, or harbour, or some place where it is possible to float a fair sized ship—in fact some navigable place; but if you told a large percentage of the well-informed of the day that it was possible to dredge an ordinary city street without any serious difficulty, with a modern "Gold Dredge," your assertion would be considered impracticable and ridiculous in the extreme. However, at the present moment in Australia dredges are working quite as dry places with comparative ease, and plants exist that work without water at all; but it is not intended to deal with them in this paper, but to confine ourselves to the floating "Bucket Dredge," and more especially to the "paddock" type of this class.

*Paper read before the New South Wales Chamber of Mines.

The gold dredge of the present day is practically the dredge we see every day at work in our harbours and rivers, deepening channels and berths for shipping, with gold saving appliances added.

The spoil of the material lifted in the case of the harbour dredge is discharged into a hopper forming part of the structure of the dredge herself, in which case the dredge is fitted with propellers like an ordinary steamship, and after filling her hopper, slips her moorings, and steams out to sea, where the doors fitted to the bottom of the hopper are dropped open, and the spoil discharged into deep water; the doors are then closed by means of powerful winches, generally fitted with "Napier differential brakes," which act automatically, and the dredge then steams back to her working ground, picks up her moorings, and repeats the process: or the dredge may not be of the "hopper" type; in this instance, the spoil is discharged into "hopper" barges, self propelled, or towed, and deposited where desired in a similar manner to that above described; the dredge herself remains on her working site, and is kept supplied with barges for removing her spoil. Little or no dredging time is lost by working on the hopper barge system.

There is no reason, nor would it cause serious delay, for dredges working at the deepening of navigable rivers, or other places found to be auriferous, from passing their spoil over gold saving appliances before discharging it into the hoppers, and the working expenses defrayed or partially defrayed, if not a profit made by the gold recovered.

The gold dredge lifts the spoil and mixes it with a sufficient quantity of water to efficiently wash it, passes it in this condition over gold saving appliances and discharges it over the stern as treated material, namely, "tailings." Briefly, the gold dredge simply lifts the material at the forward end, washes it and discharges it astern; she does not make the water in the river, if she is working in a river, any deeper, she only cuts out an excavation to suit her own requirements, which she carries along with her as she goes. I mention this latter point because many are of the opinion that dredging a river implies deepening it, even dredging it for gold; but anyone who has seen any of our rivers which have been operated upon by a gold dredge, knows, it is not so.

I am not in this paper going into details of what is or what is not suitable ground for "bucket dredging." I shall start by placing gold dredges into two classes, namely:—"River" and "Paddock" dredges, disregarding any elevating gear they may or may not have, and give the following definitions of the two classes :—

A "River" dredge is a dredge designed to work with some depth of water underneath her, and is not called upon to cut her own flotation; she is, therefore, not provided with a projecting ladder to eat into banks, or with sharpened bows to work into corners, but is, as a rule, built square across the bows, especially if working in a current, such as runs in the Molyneux, in New Zealand; for the practice there has proved that a square nosed dredge remains steadier in the current, and does not "yaw" about so much as a sharp-nosed one. Of course they offer a much greater resistance to the current and require very heavy lines to hold them, but as a dredge is not built for speed like a torpedo boat resistance is not taken into consideration to any extent, beyond the usual practice of making the floor of the pontoon take an upward curve at the bow.

In Australia, at present, we have not such a thing as a dredge of the "River" class, all the dredges being "Paddock," and it is with this latter class that I propose to deal.

A "Paddock" dredge generally commences her existence by being launched into a hole containing water sufficient to float her. This hole may be a water hole in the bed of a river or elsewhere, or may be an excavation specially prepared for her reception anywhere; and from this hole or "paddock," as it is called in dredging parlance, cuts her own way over the claim.

Assuming that the ground has been inspected by a competent engineer, and in his opinion the conditions are suitable for dredging, it is of the utmost importance that the dredge should also be suitable for the ground, that is, be capable of bottoming at any part, dealing with timber or other obstructions that may present themselves, and efficiently treat and recover as much as possible of the precious metal contained in the material lifted. She must also be so constructed that her draught of water will not prevent her floating with ease over the shallowest portions of the claim without having to lift "bottom" to do so. A "Paddock" dredge should draw as little water as possible, and the draft should not exceed 5 ft. even in large dredges; a fair average draft is about 3½ ft. to 4 ft. with a day's (twenty-four hours) fuel on board and dredge working.

The first point for the designer to decide is the dredging depth, this to a great extent fixes the length of the hull, and is measured from the water line of the "dredge" to the cutting edge of the bucket when the ladder is lying at an angle of 45° to the water line. Some dredging engineers measure what they term the "maximum dredging depth" at an angle of 55°; this you will see makes a considerable difference, and it might be as well to ask the angle when buying, or when having a dredge designed, to specify the angle. Up to the present there is no fixed standard angle.

The next point is the material to be used in the construction of the hull. In Australia timber hulls are used solely, also timber superstructures for carrying the machinery. In some dredges, however, steel gantries are used, built of angle bars and plates, and make a very light and neat structure; these will be be dealt with in detail later on. The timber used for the framework is Colonial hardwood, generally of kinds procurable in the district in which the dredge is built, and she is planked and decked with similar timber. In a number of instances oregon, and in some cases kauri, have been used for planking and decking. There are places in Australia where, owing to white ants and other destructive insects, it would not be advisable to use timber in the construction at all, and it would be necessary to adopt iron or steel in its place. For several reasons steel is the material to be used in South Africa for hull construction. In New Zeland, most of the old type of dredges were built of steel or iron, but out of some two hundred built within the last five years, there has not been, as far as I can ascertain, a single steel hull built for use there. The material used for hulls in New Zealand now being Australian hardwood (blue gum chiefly) for the framework and super-structure, kauri planking and decking. Kauri is sometimes used in the super-structure. Red pine and other local timbers were used in "boom time" and on cheap work, but they are totally unsuitable. I shall not touch upon steel hull construction, but confine my attention to timber hulls only.

The main point in a hull is to make it as stiff as possible to resist the concussion and vibration it has to withstand. Few people realise the intensely severe nature of the work dredges on our rivers and flats have to perform. Immense hardwood logs sixty or seventy feet long (with perhaps a mean diameter of four feet), which have been buried in the wash for years and covered up with gravel and *debris* of all kinds by successive floods, have to be lifted and carried clear of the dredge. Huge boulders have to be negotiated to permit the dredge to pass. Floods at times rising thirty or forty feet rush past the dredge at a perilous speed, carrying with them islands of *debris*; and sometimes the dredge next above you joins in with the flood and pays you a visit. The snapping of a line, a blow from a log of floating timber and your dredge is doomed. And, lastly, what we are now suffering from—drought with all its concomitant troubles.

If the ordinary mining speculator who does so much general all-

round growling and fault-finding would look at some of the above points in a reasonable light, his criticism would assume a milder form, and he would admit that engineers, dredgemasters, and others engaged in the industry had a lot to put up with, and that their efforts to recover the gold that all other systems had failed to get, are worthy of at least a little consideration.

From the above the necessity of a stiff construction is obvious.

The bows (noses) of all "Paddock" dredges should be well rounded to permit of being easily manipulated in a corner, and should also be more heavily planked and framed than the other portions, so that she may not be damaged by striking the face, as the dredge surges at her work. Very often the bows are sheathed with steel plates as a protection against blows and chafing.

The bottom of the hull at the forward end should be sprung or bevelled upwards for clearance and handiness in working, and the bottom from the bows aft to the position of the ladder at her "maximum dredging depth" should have the thickness of planking considerably increased to obviate accidents through logs being caught in the buckets, and by them being dragged upwards through the bottom. This type of accident is by no means infrequent.

For clearness in describing I shall refer to the dredge complete as the "dredge;" to the two pontoons (namely the "port" and the "starboard" pontoons) tied together to make one structure as the "hull." Amongst dredging hands the "hull" is usually alluded to as the "pontoon" or "pontoons," but in describing the construction it is necessary, to avoid confusion, to discriminate the terms used. The ordinary hull consists of two long narrow pontoons joined together for about a third of their length by a third small one equal in width to the width of the ladder well required. The two longitudinal sides of the third small pontoon are really a portion of the inner or well sides of the two main (or long "pontoons") before mentioned. The floor and deck beams where the three pontoons are tied together are in single lengths and are common to the three pontoons. These three pontoons form the "hull." Besides the floor and deck-beams a number of very much heavier beams also run across the entire width of the three pontoons alongside the floor and deck beams; and these are lattice braced to form thwartship girders, to overcome the tendency of the structure to "sag" inwards towards the ladder well or "hog," according to the distribution of the weights on board. In a similar manner the stringers, girders, etc. (according to the design adopted), and planking in this inner (or well) side of each pontoon are run its entire length. This construction forms the hull into three distinct water-tight compartments, namely, the two main pontoons and the small connecting pontoon. The two main pontoons are, (or ought to be), each subdivided into three water-tight compartments, making in all seven water-tight compartments in the hull. Unfortunately both here and in New Zealand, from motives of economy, and through the over-ruling power possessed by individuals totally ignorant of what is required (and what is not required), these very necessary safeguards have been omitted, and the result is that a number of our dredges have had a trip to the bottom of their paddocks, and now carry with them the effects of their immersion in the shape of twists, bends, cracked castings, machinery out of line, besides other defects added to all of which is the cost of lifting, loss of working time, etc., while current expenses are running on just the same without the necessary gold coming in to meet them.

There are several other types of construction adopted by different designers, but in all the general principal of construction is as above described. I shall briefly describe a few of them.

The Double Skin.—In this method of construction on the sides of the dredge, the outside planking is of the usual sizes, but the fore and aft stringers are done away with, and in their place very deep planks attached to the frames forming an inner but not a water-tight skin, the outside planking alone being caulked. The inner planking is secured by long vertical drift bolts. The "inner" and "outer" skins are also bolted together through the frames. For this form of construction the timber should be very well seasoned, or the shrinkage will be considerable in the wide inside timbers. The bottom, and deck are of single planking of ordinary construction.

This is a light and simple form of construction, the principal faults in it being the difficulty of locating and stopping a leak, owing to the internal side planking and the absence of diagonal bracing where the machinery happens to be heavy.

The Fore and Aft Keelson.—This is a method of construction in which the thwartship beams and floors we usually see in a ship are done away with, and a series of keelsons and fore and afters run the entire length of the pontoons in place thereof. The bottom and deck planking is laid athwartships, wide planks being used for the purpose. No side frames (or ribs) are used, but a number of stringers run the entire length of the pontoons. The side is trebly planked, that is, the planking is put on in three courses. The first is put on diagonally, at an angle of about 45° to the deck line. The second at about right angles to the first, and the third, or outer planking, horizontally as in ordinary ship work. The outer planking is caulked and felt, or "chenam" is generally interposed between each course of planking. The diagonal seams are not caulked.

Like the last method of construction, the dfficulty of locating and stopping leaks occurs. The thwartship planking is also a very weak point. It is also a simple form of construction, and quite a number of dredges have been constructed here on this principle, but only two, as far as I know, in New Zealand have heen built on this plan.

The Braced Stringer.—In this method three stringers of different sections run the entire length on each of the four sides of the pontoons the one on the bilge being generally square in section. These are bolted to the frames (or ribs) and stiffened by diagonal bracing checked on to their faces. On the inside the planking is spiked and bolted to the outer side of the frames (or ribs) and laid horizontally in one thickness. The floors are bolted to the frames (or ribs) and the deck beams to the frames (or ribs) as well as to the stringers.

This construction is a strong one, and makes an excellent job, but as it involves a lot of joiner work it is rather expensive, and it is not one that can be placed in the hands of amateurs. It must be performed by first-class tradesmen.

The Wedged Stringer.—This method is identical with the above, with the exception that long double wedges are used between the stringers and the diagonal bracing dispensed with. The bad feature in this construction is the wedges. The excessive vibration on a dredge when working causes these wedges to work loose, and they are then practically non-existent, unless they are carefully watched and kept driven hard home.

The Girder Side.—Several varieties of this form exist, but they are more or less complicated and expensive to make.

The latest New Zealand design consists of a top and bottom member of a heavy flat section. The cross bracing is used in such a manner that the lower end of the brace butts against the floor and the upper against the deck beams. The cross braces entering into and mutually assisting each other in forming a compact and highly efficient design. The top and bottom members of the girder are further tied together by "king bolts," situated in pairs in the diamond formed by each pair of cross braces. The frames (or ribs) are bolted to the outer face of the cross bracing to permit the "king bolts" to draw up, from time to time, any play that may appear in the joints of the girder, due to shrinkage in the timber, over-straining, or other causes. The planking is spiked to the ribs as in ship work. These girders extend the full width of the pontoon forming the four sides; and four or more of similar design run athwartships of the pontoon, namely, one forming the after end and one

at the end of the well, each extending the full width of the hull, and one shorter one, or two in the case of longer pontoons, athwartships in each pontoon.

This construction reduces all the defects in the others mentioned to a minimum, and possesses as well the feature of being a simple one; that is, one in which the efficiency is great, compared with the cost of labour in obtaining it

There are other constructions in which a series of girders of complicated designs run fore and aft through the centres of the pontoons, as well as forming the sides; but, in my opinion, the quantity of timber used and the labour required in their construction makes them very expensive to build, and does not warrant their adoption for this purpose. There is, however, no doubt that they possess the feature of strength in a marked degree, but are unnecessarily ponderous. These examples just mentioned practically embrace those in general use by dredging engineers, but others exist, such as the "cellular" type, etc.; but as a rule their novelty far exceeds their utility.

All the above types are stiffened laterally (that is, athwartships) by diagonal or cross bracing, and are provided with hold pillars to support the weight of the deck on which the bulk of the heavy machinery is placed, and are also capable of being sud-divided into any required number of water-tight compartments, and should be sub-divided in such a way that any one, or even two compartments, could be filled with water without sinking the dredge. Dredge owners, when placing a dredge in the hands of an engineer to design, should stipulate that water-tight compartments should be incorporated in the design, and also that these compartments should be practically tested, that is, filled with water and the effect noted. The test would cost very little, and the owners would, at all events, be satisfied that with ordinary care the chance of their dredges sinking was a remote one. Within the past two years, to my knowledge, no less than seven dredges out of a working total of thirty sunk, and two of these performed the feat twice, and quite a number of others had some very narrow squeaks for it. I mention these facts here to emphasize my remarks on the necessity of sub-dividing dredges into water-tight compartments by the simple and inexpensive method of a few water-tight bulkheads. Had the dredges alluded to in this been properly sub-divided with a few water-tight bulkheads their immersion would never have occurred.

Another point in bulkheads is that they stiffen the hull laterally (that is, athwartships), and if employed do away with a large amount of the transverse bracing, and as all the machinery, with perhaps the exception of the centrifugal pump, is usually on deck, there is no obstacle in the way of placing bulkheads or lateral bracing where required. One important point to be noticed regarding bulkheads in timber pontoons, however, is that ventilation must be provided for each compartment, in addition to the usual small hatchway.

Having dealt with the pontoon itself, the next consideration is the superstructure which consists of "tumbler framing," "gear framing," "hog framing," screen or sluice box framing," "gantry," etc., etc.

The "tumbler framing" consists of very heavy uprights and beams, cross diagonally braced and well tied in every direction with heavy tie bolts, and as it also supports the ladder with its tumbler and buckets, as well as the main tumbler with its gearing, the structure requires to be exceedingly strong and rigid to withstand the shocks it is subjected to.

The "gear framing," in construction, is similar to the tumbler framing, but considerably lighter. It is usually braced athwartships to the tumbler framing. As it supports all the intermediate gearing and shafting it also requires very rigid bracing.

The "hog framing" is constructed of vertical posts, really Samson posts, or lattice braced framing of the "A" or other types, erected where deemed necessary. Iron or steel rods, or heavy steel ropes provided with tension, or rigging screws lead from the top of these posts or frames forward and aft, for the purpose of counteracting the tendency long dredges have of hogging, that is, dropping at the stem and stern, but it is sometimes dispensed with in short dredges. The hog framing is also used as a derrick to support the elevator in dredges carrying elevators.

The "screen framing," where a screen or screens are used, is very much the same in its principle of construction as the tumbler and gear framing, and the sizes of the scantlings used are the same as in the gear framing, perhaps a bit lighter.

The "sluice box framing" follows the general design of those just mentioned, but is very much lighter still.

The "gantry" is a very important part indeed of the structure of the dredge, and more so of the "paddock" dredge, whose well, owing to the necessity of having the ladder projecting in front, must be left open forward. The gantry, therefore fulfils a dual duty; that is, it ties the two "pontoons" together, as well as sustaining a very large proportion of the weight of the ladder, amounting to many tons.

A "gantry" requires to be extremely rigid, and besides possessing the features mentioned, must also be capable of overcoming the tendency the pontoons have of sagging inwards towards the well caused by the excessive weight of the ladder being concentrated on one central point forward in the weakest portion of the dredge's structure, and for obvious reasons its weight must be centralised there or thereabout. This strain can, however, to a certain extent, be neutralised by the distribution of machinery on board. The scantlings in the gantry, if of hardwood, are very heavy, and as a rule are of similar size to those in the tumbler framing.

In an ordinary 4½ft. bucket dredge this weight varies from twenty-five to forty-five tons, according to the dredging depth and application of the strain.

The remarks I have made practically embody concisely the salient features in the construction of the hull and super-structure of a modern gold dredge built of timber. I shall now deal with the machinery to be erected on the hull.

The two most important factors in dealing with the machinery required are the dredging depth and the capacity; this allows us to arrive at the power of engine, size of buckets, etc. Before going further it might be as well to define the term "capacity" as applied to a dredge. Capacity, or nominal capacity, is the actual amount the dredge can lift ruuning full buckets, with the ladder lying at an angle of forty-five degrees. The buckets of all dredges should be so shaped that they will hold their maximum capacity at that angle. A favourite complaint from speculators in dredges that are not getting as much gold as they would like, is:—"We were told the dredge would treat one hundred and twenty tons an hour, and we have measured up what she has done and it is not half that." In the first place they have measured up the ground in the solid, quite overlooking the fact the buckets of the dredge break this down and loosen it under water, it therefore occupies considerably more space than when in the solid, that there is a lot of broken stowage in a bucket without one or two big stones in it, and running at the speed dredge buckets run (say twelve buckets a minute) a badly filled bucket will come up occasionally, in spite of the efforts of the winchman; it may be very hard cemented ground, and the dredge has to actually pick every foot of it down with her grabs, and scrape up what she can get with the buckets. or, it may be, a stiff puggy clay appears in the face, which is compressed into the buckets with the full power of the dredge, much the same as a brick machine would squeeze it into a brick mould. Now, having got this clay into the buckets, the next problem is how it is to be got out again in the interval of time lapsing between each bucket, one-twelfth of a minute (that is five seconds, it is really less) and, lastly you probaby find on discussing the matter further with them, that their dredge has struck a bit of shallow gronnd, say six or eight feet deep, and that the ladder is lying at such an angle that it would be a physical impossibility to fill the buckets to more than one third of their capacity.

The discussion generally terminates, as most of that class of discussions do, by the speculators concluding that the "dredge" is a failure. The engineers assured them she would treat one hundred and twenty tons an hour and she dosen't, and that's all they know about it.

A good deal of judgment on the part of the dredge master is required in regard to the amount advisable to lift. At times when in very rich wash of a clayey nature, it has a better chance of treatment in the screen and on the tables if passed through in smaller quantities. If, on the other hand, it is poor and of a loose gravelly nature, to make working expenses it might be necessary to push the dredge to her utmost capacity. Dredge masters, as a rule, when they get on to a rich lead or patch reduce the quantity lifted, if the dredge is running full buckets to give it a better chance of being more thoroughly washed in the gold saving appliances.

The motive power of a "Paddock" dredge is either steam, electricity, or water. Where water is used, as at Waipori, in New Zealand, Pelton wheels or some form of turbine are the generators of of the required motion. Oil engines have been suggested where fuel has to be carried long distances at a heavy rate of freight; but I am not aware of any plants at present using oil engines. Whatever motive power is used, it must be capable of being governed under all varying conditions. of load.

Dredge engines should be made with moveable eccentrics to enable them to be reversed in a few minutes, but I will draw attention to this later on under the tumblers.

Approximately about sixty per cent. of the power of the dredge is absorbed by the centrifugal pump in lifting the water for treating the wash.

The size of the engine varies with the capacity, dredging depth and water supply required for tables.

The type of engine adopted by most designers is the high pressure compound horizontal. The condenser is a surface one and of a pattern used only on dredges. The water used for washing the gold is utilised prior to going on the tables as the steam condensing medium; the condenser really forming part of the discharge pipe from the centrifugal pump to the tables or sluice box. The air and feed pumps are independent of the engine itself and are actuated by an eccentric on the first motion shaft, and this system answers very well. Engines of the marine, semi-portable, portable, undertype, rotary, etc., both high pressure as well as compound have been used for the purpose with varying success.

A sluice-box dredge, that is, one without a screen or elevator, takes about the same power to drive, owing to dredges of this class requiring more water for treating the spoil than dredges with screens and tables, and also on account of the extra height it is generally necessary to lift the water and spoil to secure sufficient fall for the sluice-box, which ought to be carried well astern, and its extreme end should be high enough to be well clear of the tailings at the highest possible stacking height of the ground to be dredged.

The boiler is generally given an excess of power, that is, for example, a 16 H.P. nominal engine is provided with a 20 H.P. nominal boiler. The horse-power in excess is given for the purpose of driving the steam winch which utilises from 4 to 8 H.P. nominal, but as it is used intermittently and not continuously the excess boiler power, if not utilised by the steam winch, is advantageous in enabling a full head of steam to be kept without difficulty for the main engine with indifferent firing (or indifferent fuel). In the past stoppages for steam, or rather the want of it, were quite a frequent occurrence.

A number of dredges have independent steam driven electric lighting plants, and these absorb from 1 to 2 H.P.

Marine portable, under-fired tubular, semi-tubular locomotive, loco-tubular boilers, etc., are used for the purpose. The loco-tubular is a favourite both here and in New Zealand, and possesses a number of excellent features for dredge work, so much so that the type is now known by the distinct name of "Dredger" boiler by the English makers.

Wood is the fuel used entirely for firing purposes in Australia.

The boiler on a dredge demands and should receive more attention than any other part of the dredge's machinery, but unfortunately gets as a rule less.

With the dirty feed water used, charged with all forms of vegetable and organic matter and mud, together with the lavish and totally unnecessary use of internal lubricants of questionable quality in the cylinders and valves of the engine itself, the risks run are very great indeed. The boiler inspection, under the Dredging Regulations of this State, is practically no inspection at all. In New Zealand all boilers are subjected to a very critical examination every six months by a Government Inspector, and a certificate given if everything is satisfactory. In this State each engineer examines his own boiler and gives his own certificate, which is obviously always satisfactory. The writer ventures to predict a "horrible sensation" on a gold dredge somewhere before very long, in which the boiler will play the "star" part. The hands on gold dredges generally do not know too much about a boiler and its possibilities, and perhaps it is as well for their own comfort that they have not been too lavishly endowed with information on this subject.

In the older type of dredges in New Zealand, as is the custom on harbour dredges, the power generated by the engine was transmitted from the engine to the top tumbler by means of shafting. In gold dredging practice this was found to be too rigid, and the continual jumps and jars of the buckets as they struck boulders, timber, or other hard obstacles in their work was very severe on the gearing and the engine itself, notwithstanding the interposed friction brake. With the object in view of softening or cushioning the shocks on the gearing and engine, the shaft between the crank shaft of the engine and the gearing was done away with; the pinion on the crank shaft of the engine was removed and a pulley substituted, more intermediate gearing was introduced, and the bevel-gearing replaced by spur-gearing; and a pulley, keyed on to the first motion shaft connected by a belt or by ropes to the pulley on the crank shaft of the engine.

This new arrangement eased matters considerably, and now practically all gold dredges are either belt or rope driven, the direct-driven type having disappeared, with the exception of a few old relics that exist in remote parts of New Zealand, more as historical objects than anything else. Bevel-gear has also gone down with its chum, the direct drive, and spur-gear has taken its place, and it in its turn, is now giving way to the helical gear.

Bevel-gear is still greatly used in harbour dredges and almost invariably the direct-drive. But in this class of dredge the working conditions are more even than in the gold dredge.

A popular misconception exists amongst a certain class of those interested in dredges as to what occurs when a dredge or rather the buckets come in contact with a hard obstacle. The impression is that something, meaning some vital portion of the machinery, must go, and in this theory see the solution of the whole problem of breakages and delays and the salvation of the industry. All that is required, so they aver, is to introduce some form of controlling or disengaging apparatus to act when the buckets strike something so hard that they are brought suddenly to a standstill (much in the same style as the barbarians of modern civilisation stop a railway waggon by spragging it, that is, throwing a short stiff piece of timber through the arms of one of the wheels while it is in motion). But I may state that every dredge in existence, whether harbour or gold, has an appliance for this purpose

known, in dredging parlance, as the friction This is so adjusted that when any undue strain comes upon the gearing it slips and stops the top tumbler from revolving until the strain is relieved, either by the winchman manipulating the ladder or the dredge herself. Directly the strain is relieved the top tumbler starts to revolve automatically. This friction apparatus can be controlled by the winchman without moving from his position at the winch, and the buckets stopped at any desired point on the ladder almost instantaneously.

The winch of a dredge occupies the same relative position to a dredge as the slide-rest does to a lathe. Assuming the buckets to be the tool, and in reality they are, the winch feeds the buckets, up or down, forwards or sideways, at the will of the winchman, who manipulates this complicated piece of mechanism. Too much importance cannot be attached to having an efficient winch : however perfect the rest of the design may be, a defective winch neutralizes all its good points. Strength and quickness in manipulation are the main desiderata in its design.

In an ordinary 4½ ft. bucket dredge with, say, a dredging depth of thirty five to forty feet, the winch must be capable of lifting with reasonable speed and ease from thirty to forty tons. This should convey some idea of what is expected from a dredge winch.

In harbor dredges a number of single winches are used, that is, each line has an independent winch, or the lines are grouped on two or three separate winches; say, for instance, the forward lines on one winch, the after lines on another, and the ladder and head lines on another. The single winch for each line necessarily requires several extra men to manipulate them, and as harbor dredges are generally run by governments, harbor trusts, or large public bodies who have plenty of money to spend, the cost of labor is not a serious consideration.

The crew of a gold dredge lifting two hundred and sixty tons per hour is two men per shift. The crew of a harbor dredge doing the same work is twelve men per shift, namely, engineer in charge, mate, fireman, four seamen, two deck hands, two punthands and a carpenter. The larger dredges carry in addition a blacksmith and a boiler-maker, and have a complete plant for effecting their own repairs on board, including a lathe, steam hammer, etc.

On a gold dredge the general practice is to have all lines, namely, head, ladder, port bow-line, port stern or quarter line, starboard bow-line, and starboard stern or quarter line, all on the one winch. Some of the big Molyneux dredges have an independent winch for a preventer line, which is a duplicate head-line to guard against accident. The preventer-line and head-lines being lines that are very seldom used compared with the side-lines and ladder-line, which are almost continuously on the move.

In the original gold dredges, chains were used for mooring purposes, and a number of common crab winches were utilized, generally one for each line (six winches). These crab-winches were manipulated by hand, so the winchman had a good deal of walking about. The next progressive step was the assembling of the six lines on a single winch, which at that time was merely a group of capstans or surging drums, round each of which the respective chains took several turns and fell into a chain locker below deck. The handling of these chains was most laborious work, and in a current like the Molyneux in New Zealand it can be better imagined than described, if the powers of imagination are vivid enough. Harbor dredges still use chains universally, but gold dredges have discarded them entirely and steel ropes have taken their place.

In some dredges the winch is driven by means of belts, ropes, or intermediate gear off the main gearing, but this method is not without its disadvantages and is only adopted in plants where the first cost is the main consideration. It necessitates the running of practically the whole machinery of the dredge to simply operate the winch when found necessary to pull the dredge to anywhere when the main machinery is at a stand-still, say running out or in a line, heaving up a log out of the face, etc.

The modern winch is a complex piece of mechanism, driven by an independent steam engine, or in electric dredges by an independent motor, on which the whole of the six lines can be manipulated with ease by the winchman without moving from his position.

The gearing of a gold dredge, needless to say, must be of the heaviest order, and the greatest care should be exercised in its design and the materials used in its construction. All pinions should be preferably made of cast steel, and cast steel should enter largely into the construction of a dredge generally. Accidents through light or defective gearing are a very common source of delays. Too much stress cannot be laid on the necessity of taking the greatest care of this very important element in the dredge's structure.

The buckets and their accessories, namely, grabs, links and pins, are all the product of the forge or boiler shops, very little cast work of any description enters into their construction in gold dredges. In harbor dredges cast steel buckets and links are in common use, but so far gold dredges have not adopted them.

Manganese steel is the material in general use in bucket pins, but there are other brands of steel equally suitable for the purpose.

In this State very much heavier pins are used than in New Zealand, practically owing to the heavier nature of the ground, and for the same reason the lips and bodies of the buckets as well as the main links are very much heavier.

Spring steel is the material used for bucket lips, and at one time these used to be hardened by tempering; this practice is, however, abolished. The life of a heavy bucket lip in Australia is from four in hard ground to eight months in easy ground. A great deal depends on the way a dredge is handled, and in the lifetimes mentioned it is assumed that they get fair usage and are not made to perform similar duties to a "stone-crusher," "quartz-stamper," or "forest-devil."

There is a great deal more in the design of a bucket than at first meets the eye, and each designer has some particular curve or set in the development of his bucket for which he claims some distinct advantage. There is no doubt that there is a great deal in this very important element of the structure, and as I before compared the winch to the slide-rest of a lathe, we might here extend the comparison and call the bucket the cutting tool, and every engineer knows the importance of the shape of the cutting tool. Every turner has his own particular little twist, lip, or clearance in the same manner as the dredge designer humors his little fancies with the bucket. The whole idea in the design of the turning lathe is to give the cutting tool the best possible chance to do its work; the whole design of a gold dredge (with perhaps the exception of the gold saving and tailings stacking appliances) is to give the bucket the best possible chance of doing its work.

A broken bucket pin is the commonest of all accidents; it averages on the aggregate in this State about two a week. The writer knows of a dredge in Victoria that ran for more than six months without breaking a pin, but this is a record performance. The time occupied in stopping the dredge and putting in a new pin is under half an hour. One of the most aggravating accidents that can happen on a dredge is the snapping of two opposite pins, this generally results in all the buckets and links *i.e.*, the bucket belt, as it is commonly called) dropping into the bottom of the paddock or the river, if a river dredge. Fortune might smile upon you to the extent of permitting one end to remain on board, then with a smart crew and a reversible engine it is only about two or rhree hours work to get them coupled up again, but if you are not so favored,

then it is a fishing job in the muddy water of the paddock or river, and you always seem to get hold of the wrong bucket, or wrong end first, and have to overhaul the lot or a large number of them. If the accident happens in say thirty feet of water the belt, in dropping, forms itself automatically into loops and almost knots, and the excessive weight of the falling mass jams and interlocks buckets, links and pins into an almost hopeless tangle. It sometimes happens in grappling that the bite, or a portion of the end of the belt is drawn through a loop in another portion, actually forming a knot. In an ordinary 4½ ft. bucket dredge with a dredging depth of 35 ft., there are thirty-six sets of buckets, links and pins, each set weighing over eight hundredweight, or a total weight of fourteen and a half tons to drag up without any allowance for spoil that may be in the buckets themselves. With a smile or two from fortune, a good crew and suitable tackle, you might get the bett on again in twenty-four hours; but if the belt is badly tangled up it may mean several days. The Molyneux is a bad place to lose the bucket-belt in.

When the winchman notices that the belt has snapped he should stop the main engine instantly, if possible, but under no circumstances whatever should he pull out the friction, for in so doing he throws away the only possible hope he has of holding on to the end of the belt and checking it from going over the top-tumbler. In releasing the main friction he practically converts the top tumbler into a loose roller for the belt to run off on. Many a belt accident would have been averted had the winchman acted as advised here. A bucket-belt almost invariably goes on the ascending portion, so that besides being heard—for it gives a loud report—it is always within the view of the winchman. This type of accident fortunately is not a common one.

Bessemer steel of boiler quality is the material used for the bodies of the buckets and generally tire steel for the main links. Old railway rolling stock tires make excellent links.

The running speed of buckets varies from ten to fourteen buckets per minute.

The ladder, in its early stages, was constructed of wood, but wooden ladders are a thing of the past. The modern ladder is simply a very strong steel girder suspended or pivoted at one end, and free to move up and down at the other as required and is designed on very nearly identical lines. On the top side of the ladder are a number of rollers extending almost the full width of the ladder, and on these rollers the bucket-belt travels. The types of ladders used vary from the elementary channel-bar pattern, which consists of two parallel channel-bars of a deep section, with distance pieces between to retain them at the width desired for the ladder, to the elaborate braced plate-girder and box-girder patterns.

The lower end of the ladder forms a jaw which is fitted with bearings on each side. The bottom tumbler fits into the jaw and revolves, either on a stationery shaft, or is keyed to a shaft which revolves in bearings provided on either side of the jaw for it. A ladder must be an exceedingly strong and carefully designed structure.

The snapping of a ladder is not an unknown accident by any means, and when it does go, it is generally about two-thirds of the way down. Ladders also have a weakness for twisting, that must be allowed for in the design. A twisted ladder gives a lot of trouble.

To be continued.

Granby Consolidated Mining and Smelting Company.—Mr. Jay P. Graves in a recent interview says :—"With the development work accomplished and the plant in place and in transit, the Granby mines at Phœnix are capable of producing 5000 tons of ore per diem for shipment to the company's reduction works at Grand Forks. We are unable, of course, to treat anything like this tonnage with the present smelting plant, but our plans are to inaugurate a program of extensive additions that will increase the capacity of the works, and eventually bring it up to the same standard that has been reached at the mines. An appropriation of approximately $250,000 will be required to accomplish this end, and considerable time will be required to work out all the plans in contemplation. We will undoubtedly make a start at a comparatively early date, however, and keep at the proposition until the end in view is attained."

Mica Production in the United States.

In the advance sheets of that excellent publication of Dr. David T. Day's, "The Mineral Resources of the United States," published by the United States Government, some very interesting figures are given of production of mica across the border. From this article it would appear that the total plate mica produced in the United States during the year 1901 was 360,000 pounds, valued at $98,859, as compared with 456,283 pounds, valued at $92,758, in 1900. During the past two years there has been a large increase in the amount of mica produced, with, however, but a slight increase in value, a condition which is undoubtedly due to the very large amount of small-sized mica disc and rectangular sheets that have been cut for electrical purposes, and that has in former years been used as scrap mica. Some of this plate mica has been obtained from old mica dumps. There was a large falling off in the amount of scrap mica produced in 1901, which has been estimated as 2,171 short tons, valued at $19,719, as compared with 5,497 tons, valued at $55,502, in 1900. This falling off in the production of scrap mica is undoubtedly due to the exhaustion of the large piles of scrap that had accumulated during the last quarter of a century, when there was a market only for plate mica.

The relatively small production of mica can be accounted for by the low prices maintained for plate mica, by the uncertainty of the occurrence of the mica in the veins, and by the large number of small producers who are entirely dependent upon one small mine, and who, when the mica in this begins to give out or is poor, have not the means to carry on much dead work, and have no other deposit to help fill out this deficiency. The consolidation of a number of the mica mines in different sections might be profitable. The importation of mica from Canada and India at a low valuation tends also to curtail the production of mica in the United States. This is especially true of the mica imported from India, which can be mined and landed in this country at a lower price than, in some cases, it can be mined in the United States.

The production of mica during 1900 and 1901, by States, is given in the following tables :

Production of mica in 1900, by States.

State.	Sheet mica.	Scrap mica.
	Pounds.	Short tons.
New Hampshire	191,118	645
North Carolina	107,255	4,450
South Dakota	*a* 123,090	80
New Mexico	9,620	258
Virginia	16,000	....
Other States *b*	9,200	64
Total	456,283	5,497

a Sold in rough or unmanufactured condition *b* Idaho, Maine, Nevada and Rhode Island.

Production of mica in 1901, by States.

State.	Sheet mica.	Scrap mica.
	Pounds.	Short tons
New Hampshire	65,800	250
New Mexico	3,100	146
North Carolina	266,160	1,775
South Dakota	25,000	....
Total	360,060	2,171

As is seen from the above tables, Idaho, Maine, Nevada, Rhode Island, and Virginia, which were producers of mica in 1900, had no production during 1901, and there was a very noticeable falling off in the production of the other States, with the exception of North Carolina. In North Carolina there was a decided increase in the production of plate mica, but a large falling off in the production of scrap mica.

COMPANY NOTES.

Canadian-American Coal and Coke Co.—At this company's colliery at Frank Alta., work is proceeding briskly and the output for November has been the best since the colliery was opened. The main entry, which is being driven ahead as fast as possible, is now in on the coal seam a distance of over one mile and has reached a vertical depth on the vein of over 1,000 feet. The quality of the coal has much improved with depth and that being taken out in the main entry and deeper workings is of a very superior quality. The lower entry is also being driven ahead and is now in some 1 600 feet. With two air shafts through to the surface and the big fan driving 22,000 cubic feet of air into the workings, the Frank coal mine is one of the best ventilated properties in the Dominion. Over 150 men are now employed by the company, and as soon as more cars are available and the loading facilities improved there will be work for twice that number of men.

Bosun Mines Limited.—Head office reports 60 tons galena and 100 tons zinc shipped during the month of October.

Hall Mining and Smelting Co.—The report of the directors of the Hall Mining and Smelting Company, Limited, for the year ended June 30, 1902, which will be presented to the shareholders at the third ordinary general meeting on the 23rd inst., states that in consequence of the exhaustion of the ore reserves, and the necessity therefore for writing off the amount of £19,751, charged to development account at June 30, 1901, and also writing off £1 094 from the value of the mine supplies, there is a loss on the mining account of £6 980; on the other hand, the smelting account shows a profit of £5.071. After taking credit for sundry receipts, £1,735, and providing for the general expenses, including debenture interest and the balance of preliminary expenses not dealt with last year (together £5,772), there is a loss of £5,945 which, together with £6,673 written off for depreciation, must be added to the amount brought forward from last year—viz., £6,980 —making a total debit balance to be carried forward of £19 599. It was not until the spring of the year that the permanence of the ore body at the lower levels became doubtful. Before deciding to abandon operations, the board subsequently had the mine examined by the best expert available, whose views entirely coincided with those of the other two. The board have leased the mine to Mr. M. S. Davys, formerly superintendent, on satisfactory terms, one of the conditions being that they can resume possession, should they wish to do so, whenever the output reaches 50 tons a day. The advantage of this arrangement is that the mine will be thoroughly explored by one who knows the property well and has faith in his ability to find other ore bodies entirely free of expense to the company. Smelting.—The most serious obstacle to the expansion of this branch of the company's business has again been the loss caused by the fall in the prices of metals. Some further extension of the time for final settlement of purchase is necessary, and steps to that end will be taken as soon as possible. Notwithstanding the difficulties which have had to be met, the business still shows a profit, and there is every reason to expect reasonable profits in the future, more especially owing to the cheapening of flux and to the reduction of working expenses through the installation of the elecric plant. As soon as a refinery is erected in the immediate vicinity there will be a considerable saving in the freight which now has to be paid for sending the bullion to a distant refinery in the States. Recognizing the desirability of reducing the management expenses, the board have decided to reduce their number to three.

Ymir Gold Mine, Limited.—An extraordinary meeting of the Ymir Gold Mines, Ltd., is called for 29th inst., to consider a reconstruction scheme in terms of the following circular, which has just been issued:—It will be remembered, the directors observe, that at the annual meeting held on 6th May last, a resolution was passed sanctioning an increase in the capital for the purpose of providing funds to pay for the installation of the cyanide plant, and for the further development of the mine. On reference to the circular of 15th August last, which enclosed Mr. Hooper's report upon the mine, it will be seen that at the extreme eastern end of the tunnel at the 1,000 ft. level, where the work was suspended, the values were found to be higher than at any other part of the vein at this level. From this fact, and from the general tenor of Mr. Hooper's report, the directors have great confidence that as further development is accomplished the mine will prove to be as valuable as was ever expected. To enable this development to be systematically carried out, it is necessary to provide additional funds. Under present market conditions, it is obviously impossible, they add, to increase the capital. In order to pay off the company's liabilities for the cyanide plant (which is now in satisfactory operation), liquidate the bank loan and make provision for the requisite additional working capital, the directors recommend that the company be reconstructed on the basis of an assessment of 3s. per share on the issued capital of £200,000, payable as to 6d. per share on the application, and 1s. per share on allotment, and the balance in calls of 6d. per share at intervals of not less than one month. The effect of this arrangement will be, they say, to free the company from all its liabilities, and leave it with ample working capital for further development work. It will be remembered, they conclude, that during the four years the company has been in operation it has made profits sufficient to invest £46,000 in permanent works and development, and has also distributed £60,000 in dividends. The work of connecting the No. 10 tunnel with the upper workings by means of an upraise (which is now in progress) is necessary for the economical development of the mine. Until this is completed it is only possible to keep 50 stamps at work.

Chippewa Consolidated Gold Mining Co.—This company operating the Wendigo gold mine, Lake of the Woods, has been overhauling the old plant and getting the mine in shape for the resumption of mining. Under capable management this property should do well.

Camp Bird.—The secretary states:—"The following cable has been received from the mine manager, reporting for the month of Septeuber:—The mill ran 29 days and crushed 5,450 tons of dry ore. Bullion sales (including cyanide bullion, estimated at $9,000). $112,500; concentrates (340 tons), $32,000—$144,500. Working expenses and developments, $53,150, leaving the profit of the mine at $91,350, equal to, say, £18,800. From this should be deducted the monthly expenses in London (including consulting engineer's fee) of about £700, leaving a profit for the month estimated at £18,100. There has been expended on construction account since the property was taken over to 30th September, $29,705, say, £6,112."

Velvet Rossland.—The manager cables the following returns from smelter:—"180 tons yielded 184 ozs. gold, 156 ozs. silver, 24,363 lbs. copper. Net proceeds from smelter $4,078, or an average of £4 10s. per ton net."

Hastings (B.C.) Exploration Co.—At the meeting of this company held in London during the early part of the present year, the directors gave a very gloomy report on the Arlington mine at Erie which is one of the principal assets of the company. They informed the shareholders that according to the latest expert advice the mine appeared to have been gutted and all the pay ore practically worked out. Since then, however, it is reported that new bodies of ore have been discovered and come under treatment, which will give a new life to the property. The total shipments of ore concentrates during the past summer are as follows:—

May	65.5	$2,488
June	119	4,610
July	122	4,171
August	120	3,721
September	122	4,604
Total	548.5	$19,594

Showing a net average value of over $35 per ton.

Montreal & Boston Copper Company.—The company's operations have been running very smoothly since September 17. The company is building a brick engine and blower room, 120 ft. by 38 ft., installing 2 new 125-h.p. high-pressure boilers, a No. 7 Connorsville blower, direct connected to an engine, another furnace 176 by 40 in., and expects all this equipment to be running by January 1. Manager Goodell expects to place an order for a third furnace soon, and have 3 furnaces in blast by March 1. The company's ore supply is pronounced ample. The matte is contracted to the Granby Mining and Smelting Company.

Le Roi Mining Co.—Mr. Mackenzie's report covering the operations of the company for September shows that the profits from the ore shipped, though not as high as in previous months, were satisfactory. The tonnage shipped during the month, together with its contents and gross value, was as follows:—

Dry tons—First class, 13,667; second class dump, 1,999; total, 15,666.
Ozs Au.—First class, 6,778; second class dump, 660; total, 7,438.
Ozs. Ag.—First class, 12,145; second class dump, 933; total, 13,078.
Pounds Cu., wet—First class, 580,005; second class dump, 50,722; total, 630,727.
Value per ton—First class, $15.26; second class dump, $9.76.

The cost of breaking and delivering the first class ore on the railroad cars was $2.65 per ton, while the cost of development was equal to $1.25 per ton—increases of 25c. and 51c. per ton respectively as compared with August. The explanation for the relatively higher expenditure is found in the facts that the tonnage stoped during September was smaller and the exploration work greater than was the case in the previous month.

Mine Expenditure.—The expenditure for the month on mine account was $54,054.

Northport Smelter.—The expenditure for the month was $157,843. The public ores purchased during the month amounted to 5,740 tons, containing 2,953 ounces of gold, 6,080 ounces of silver, 282,825 pounds of copper. The tonnage treated during the month was 23,681 wet tons, segregated as follows:

Roasted ores	15,234
Raw ores, Le Roi	198
Raw ores, Le Roi second class	2,537
Raw ores, public	5,712

Estimated Profit for Month.

The gross value of the first class ore shipped from the mine was $15.26 per ton, equal to	$208,558
From this deduct smelter losses, refiners' settlement rates and interest on gold and silver values for 90 days and copper 60 days, at 6 per cent. equal to $2.61 per ton	35,671
	$172,887
Deduct cost of mining and smelting at $8.18 per ton	111,796
Net estimated profit on first class ore	$61,091
The gross value of the second class dump ore shipped from the mine was $9.76, equal to	$19,519
From this deduct smelter losses, refiners' settlement rates and interest on gold and silver values for 90 days and copper 60 days, at 6 per cent., equal to $1.56 per ton	3,118
	$16,391
Deduct cost of loading and smelting, at $4.44	8,875
Net estimated profit on second class ore	$7,516

The total estimated profit as above amounts to $68,607.51, being greater by nearly $6,000 than estimated in the cabled returns of the 6th inst., owing to the fact that the smelting costs proved to be lower than anticipated.

Le Roi No. 2.—Under date Rossland, 9th November, the company's manager telegraphs as follows:—"Shipments last month amounted to 2,413 tons; contents, 1,042 ozs. of gold, 3 360 ozs. of silver, 66 tons copper. The returns from ore amount to $19.390. Having located with diamond drill on 300 ft. level to the west of tramway dyke upward continuation of ore body. Over footwall stope above 500 ft. level diamond drill core shows the ore is 10 ft. thick; average of three assays is—gold $96 per ton, copper 2½ per cent. Will probably require to crosscut to the south 95 ft. to open shoot; have started to crosscut for ore body." [September: 6,070 tons, value $86,351.]

Centre Star Mining Co.—The annual meeting of the Centre Star Mining Company was held on the 27th, and the various reports presented. The financial statement shows that the indebtedness of the company had been reduced to $160.028 two months ago, and was being reduced at the rate of $30,000 a month, which would make it about $100,000 now. During the year $29,836 has been written off for the depreciation. The assets include $3,300,540, the value of the Centre Star mine; $1,480 cash in bank; $220,938, machinery and buildings; $16,250 in stocks of other companies; and $10,629 accounts receivable. Mining and development have cost $172,552, and diamond drill prospecting $8 371. Manager Kirby, in his report, said:—"The condition of the Centre Star mine has been improved during the year. The reserves of pay ore have been incresed, and the heavy decline in copper has been more than offset by the reduction in smelting rates, and the satisfactory solution of the problem of treating the low grades by milling, now makes it certain that large bodies of the ore exposed will soon be available. Ore sales during the year were 11,987 tons, averaging $13.31, smelters' gross assay value. The development of the mine has from the beginning continued to expose large quantities of ore too low in grade for smelting, but rich enough to promise a handsome profit to successful milling, and now that the difficulties of such treatment have been overcome, these low grade masses will soon be available." The net proceeds from ore sales were $89,752. The directors were re-elected.

Mikado Gold Mining Co.—The following is extracted from the proceedings of the last annual meeting of this company held this month in London:—The Secretary (Mr. C. F. MacNicol) having read the notice and the auditor's certificate, the Chairman said: The accounts are full and exhaustive, and do not call for any particular remark. The expenditure has been very closely watched, both at the mine and in England, and we feel assured that we have received full value for our money. Unfortunately, it has not been possible to show a profit. Mining is proverbially uncertain, and it seems that the Mikado has been particularly unlucky. It started with rich ore, in what appeared to be a permanent shute, and this continued to a depth of 240 ft. in No. 1 lode. No. 2 lode did not yield so well, but produced payable quartz, and there seemed every probability that the forecast, on which we raised additional capital, would have been verified. Unfortunately, in both lodes the values steadily decreased, and the further sinking and driving on No. 1 lode showed that the shute of ore became very much shorter and poorer, so that on reaching the 10th level, at a depth of 600 ft. from surface, it had so dwindled away in extent and value as to make it unadvisable to continue further sinking. Similarly, at No. 2 lode, the ore cut out at a depth of 300 ft. Such being the disappointing condition of affairs, it was resolved to continue the driving of No. 9 level at a depth of 540 ft., to search for another run of ore, and also to intersect the cross-lode No. 3, known to exist at a distance on surface at about 1,200 ft. south of the main shaft, it being probable that at the junction of these lodes an improvement in value would take place. Accordingly, during the greater part of 1901, and up to the present date, this No. 9 level has been pushed forward, and it is now thought that it should be within a short distance of the intersection with No. 3 lode. In the meantime, ore of low grade was raised from the old workings and milled, which has helped to pay the mine expenses; but latterly the supply has fallen off both in quantity and quality. It was therefore decided to shut down the mill and proceed only with development. I now come to an encouraging feature in our working. In 1898, when the mine was looking well, particularly in its southern section, all the levels were driven in that direction in the extension of the rich shute of ore, and no work was done to the northward of the main shaft, except at No. 4 level, which was driven for about 400 ft. Only a small bunch of payable ore was found; the vein dwindled down to 6 in. of barren quartz, so no further work was done.

During the winter of 1897-98 it was resolved to take advantage of the frozen state of the lake and to put down a diamond drill hole, to test the position and value of the lode under the lake. This was done at a distance of about 1,400 ft. from the main shaft, the lode being cut at a vertical depth of 176 ft. Taking the distance on the incline of the boring, small strings of quartz carrying small values were met with at 170 ft. and 179 ft. A large rib was found between 207 ft and 216 ft., assaying $2.50, and another, apparently the footwall of the lode, between 230 ft. and 237 ft.; this gave a value of $17 per ton. The continuity of the lode was thus proved. This and its value were further tested by a Toronto company, who bored on an island about half a mile from our northern boundary, and there met with the lode, said to assay $20. This boring disclosed the important fact that the lode was in granite formation. Hitherto our workings to the southward had been along the contact of the granite and trap, sometimes piercing a considerable length of the former, where the best ore was always found, the quartz being pinched and poor in the trap. We therefore hope that, as the 4th level progresses into the granite zone lying to the northward, so the value will increase. As you will see from the manager's cable, dated October 23, in the report, the lode is widening out, and payable ore has been found. And a cable received yesterday reports that 50 ft. have been driven in No. 4 level, that the lode is 2 ft. wide, and averages $7 per ton, with every prospect that the ore will continue. This is very encouraging. Unfortunately, as you will see from the directors' report, our funds are exhausted, and it is necessary to consider the best means of raising money to continue working. This is having our very careful thought, and several schemes are under consideration. We are taking the advice of several of our largest shareholders, and very shortly the result of the deliberations will be placed before you. Your directors are strongly impressed with the value of our property, and it is impossible to conceive that a mine, which has produced some £80,000 in smelted gold from a very small section, should be played out, seeing that its area is some 300 acres, and that several lodes, not yet explored, are known to exist within our boundaries.

The board therefore believe, with the information already gained, it would be judicious, in the interest of all concerned, that more money should be found to prosecute further work. As I have already said, our funds are exhausted. We are in debt to the extent of between £2,000 and £3,000, which, together with the amount necessary to carry out the economical policy suggested by the manager in his latest communication, makes it obligatory to raise at least £5,000. This may be done by the issue of the £12,500 reserve capital; but as it may not be possible to get shareholders to take this up at par, the only alternative short of reconstruction would be the issue of a small amount of debentures on the security of the property and assets of the company. The directors would be glad of any suggestion from shareholders now present before putting any scheme before them for raising the necessary funds. Shareholders may feel assured that any money will be expended by our manager to the best advantage when I tell you that for many months the entire charges at the mine worked out at the very low rate of $3½ per ton of ore treated. This included mining, milling, cyaniding, development and management. I do not think that there is any mine in Canada or the United States worked by steam which will show such excellent working costs. This is due to the very careful and complete accounts kept by our manager, whereby every item of expenditure can be checked and compared; so that any undue cost under any particular head of account can be at once detected and rectified. I beg now to move the resolution: "That the report of the directors and statement of accounts be received and adopted."

Nova Scotia & Baltimore Mining Company.—The work in Cariboo District, on the Lake lode, is of great importance to the district and to the gold mining interests of the Province. For a number of years mining has been done to a depth of 300 and 400 ft., the one at this depth being low grade. The company having erected a modern 40-stamp mill and adequate appliances to sink deeper, determined to sink to 1,000 ft. At 700 feet, much better ore has been struck, and from a level driven at this point 350 tons of ore yielded 1.6 oz. to the ton. The lode is from 4 ft. to 8 ft. thick.

Canadian Smelting Works.—The report is current that the refining process in practice at the Trail smelter for some months past has given such satisfaction as to justify the Canadian Smelting Works in branching out somewhat extensively in the refining business. The process is an electrolitic system, and the Trail refinery has been turning out about ten tons of refined lead for six months or thereabouts. Their new plant will be on a considerably enhanced scale, although no details have been divulged on this point as yet. The company is said to be hesitating between sites at Nelson, B.C., and a point on tide-water, with the chances in favor of their choosing the inland point. Being closely identified with the Canadian Pacific system it is not so essential that the refinery should be constructed at tidewater as would be the case with a strictly independent plant. The important feature of the matter is that the company has concluded that there is a future for lead refining in Canada, and it is somewhat significant also, inasmuch as a corporation so closely identified with the great railroad lobby would scarcely venture a large investment in refining works had it not an assurance that the forthcoming session of the House of Commons would witness such measures of protection as will substantially assist the Canadian lead industry.

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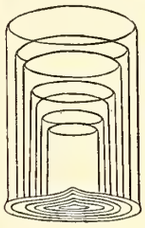
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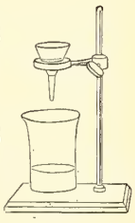
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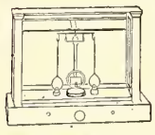
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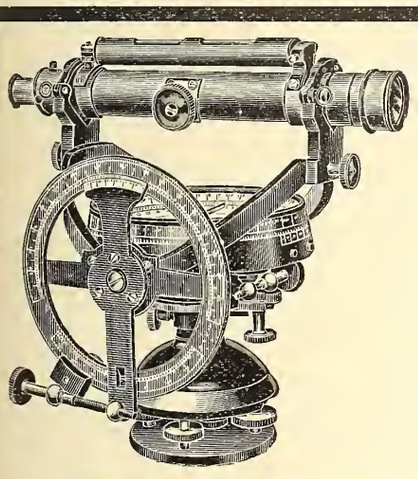
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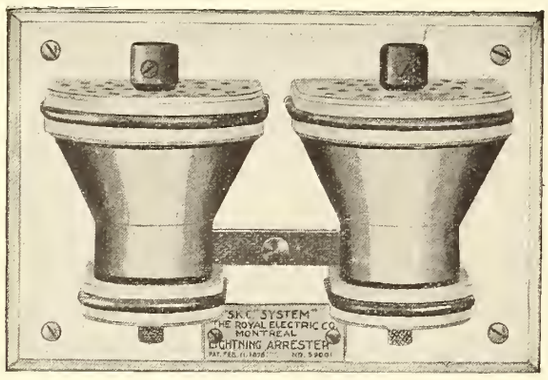
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TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of Chap. 1. Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

PROVINCE of QUEBEC

The attention of Miners and Capitalists in the United States and in Europe is invited to the

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Open for investment in the Province of Quebec.

Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not iess than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less, but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in-Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental – such royalties, unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at th mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order-in-Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end of the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 per acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee, $5.00, renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings, but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed or bars in the rivers below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River, and Hill claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim must hold a Free Miner's certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of 2½ per cent. on the value of the gold shipped from the Territory to be paid to the Comptroller.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek, or gulch, but the same miner may hold any number of claims by purchase, and Free Miners may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch, or river, by giving notice, and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00, and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette.*

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, at the rate of 2½ per cent. on the value of the gold shipped from the Territory. Operations must be commenced within one year from the date of the lease, and not less than $5,000.00 must be expended annually. The lease excludes all base metals, quartz, and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery, at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite : copper in sulphide and native form ; gold, mostly in free milling quartz ; silver, native and sulphides ; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc , apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

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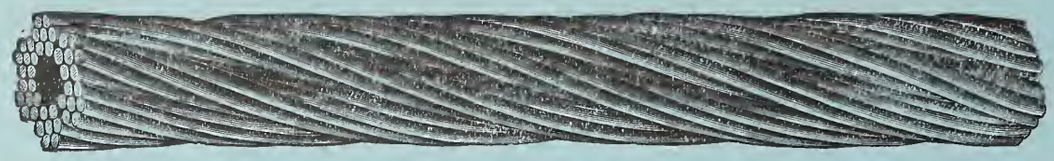
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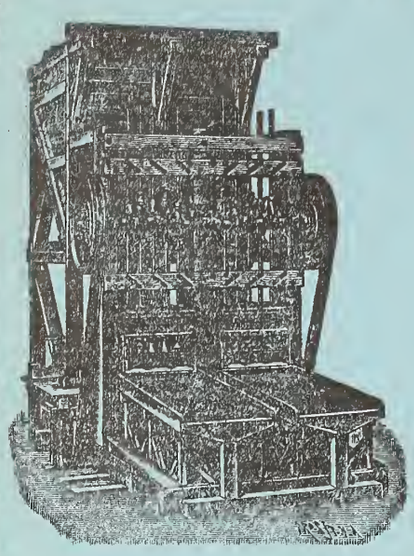
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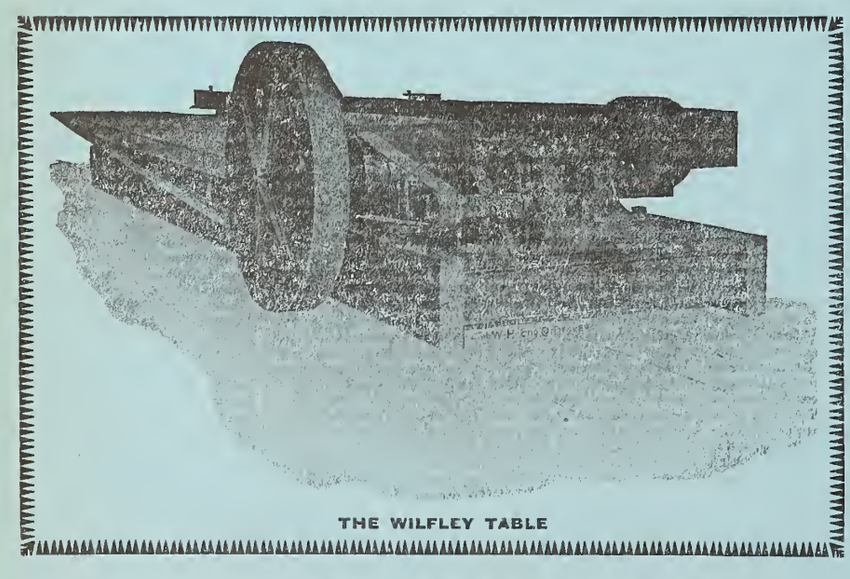
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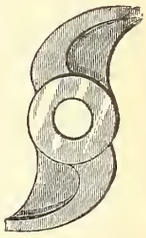


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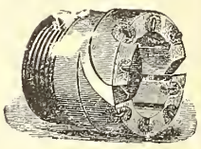


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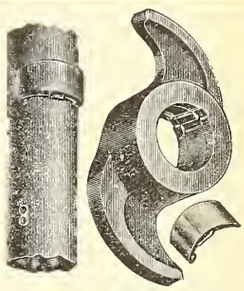


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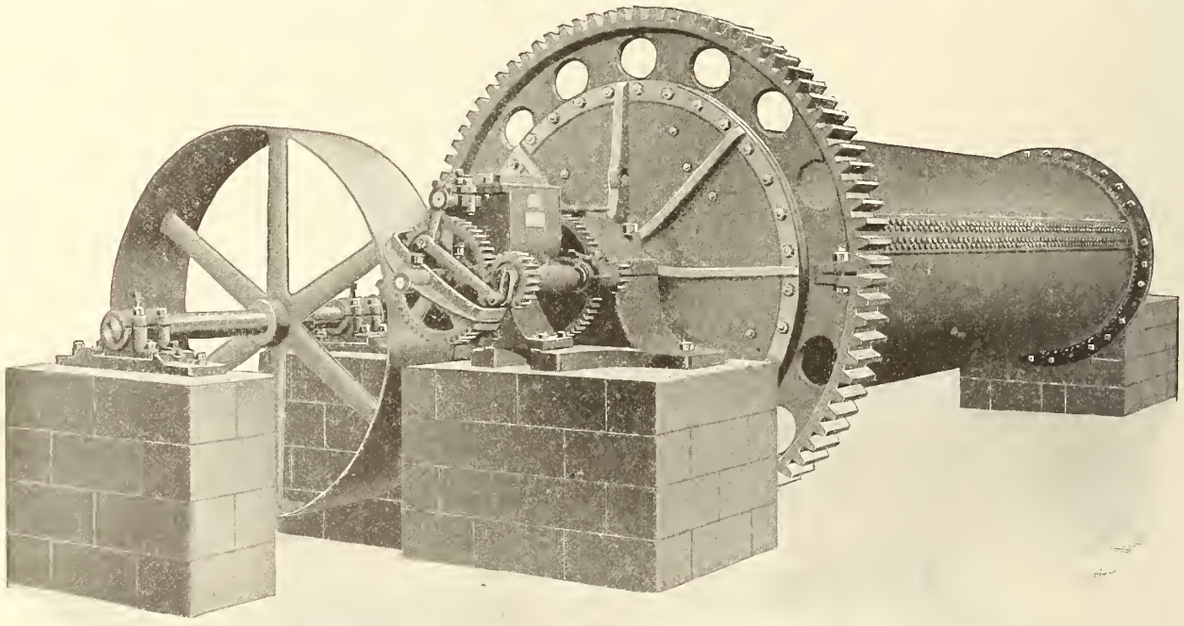
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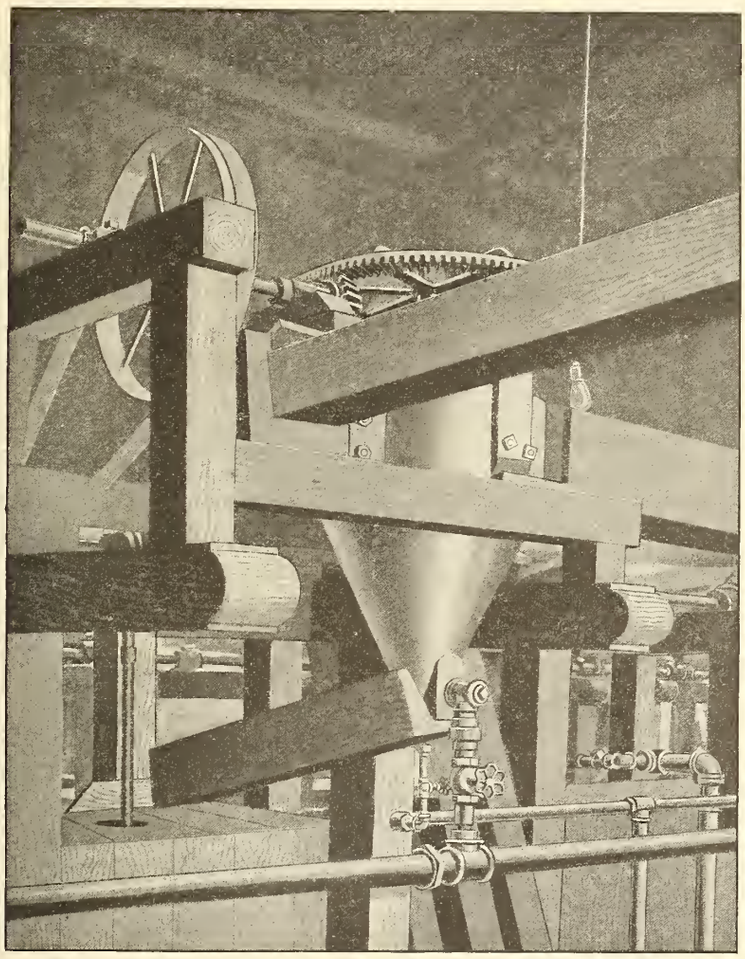
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Klein Medium Classifier in the Desloge Cons. Lead Company's Mill, Desloge, Mo.

Klein Combination Classifier

This classifier embodies a new principle, viz: the use of compressed air with the water to effect the sizing, thus greatly reducing the quantity of water ordinarily required.

It is a well recognized fact that to obtain good results in concentration, a very careful, complete and accurate sizing of the material must be made.

It is also necessary to make a complete separation of the slimes from each sizing, as they invariably contain considerable values, which, if mixed with coarser material, would be lost.

The Klein Combination Classifier will do this without any difficulty, thus permitting separate treatment of the slimes mixed with a minimum quantity of water.

This classifier can be used to size, or separate, materials crushed to 6 millimeters and finer down to the most minute particles; it, therefore, will dispense with the use of sizing trommels for material finer than 6 millimeters, and this will be a great item of saving in the renewal of perforated coverings, as well as in the loss of time incident to these renewals.

These classifiers have now been in use for over two years and therefore are not an experiment.

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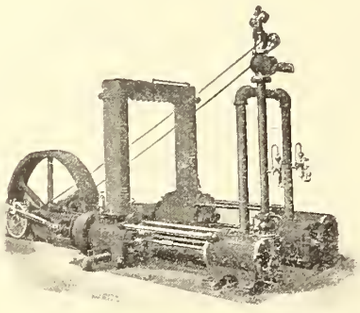
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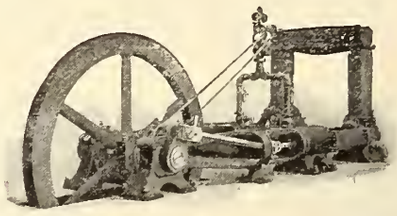
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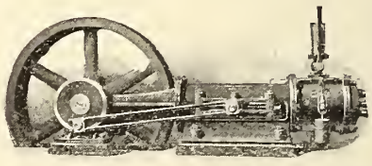
AIR COMPRESSORS



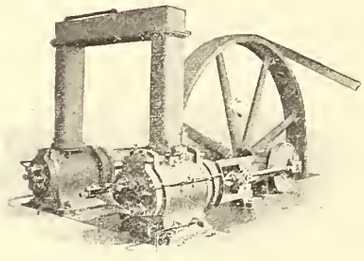
Class B-D Compressor
[Air Cylinders next to Frame]



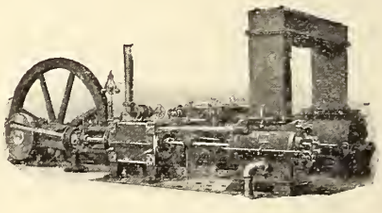
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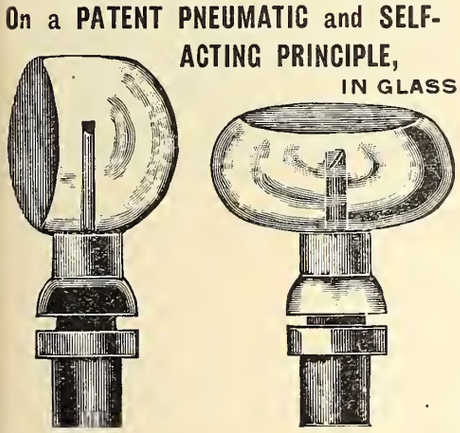
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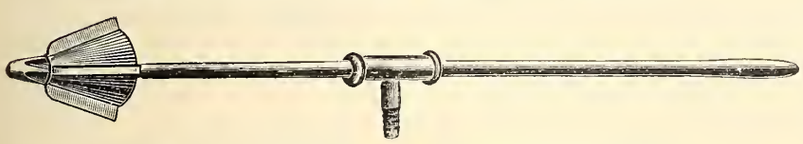
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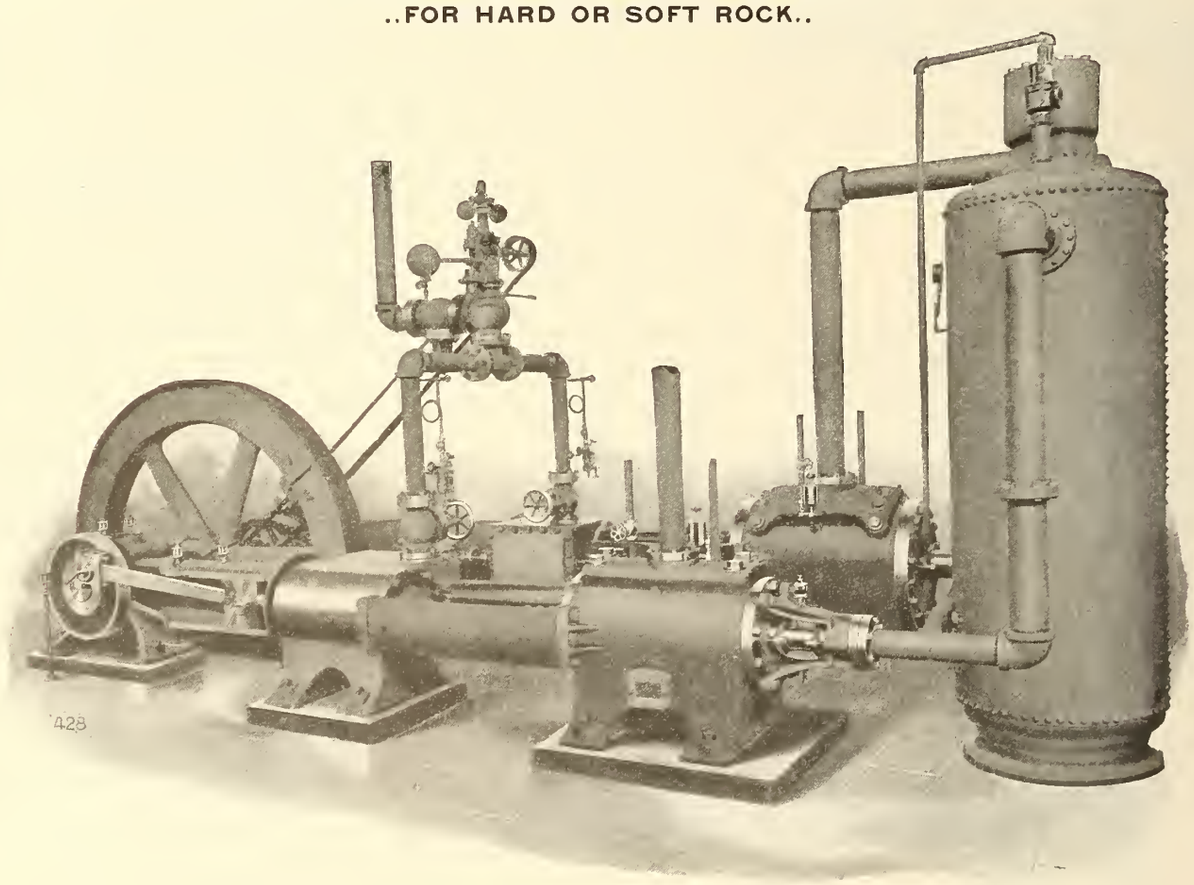
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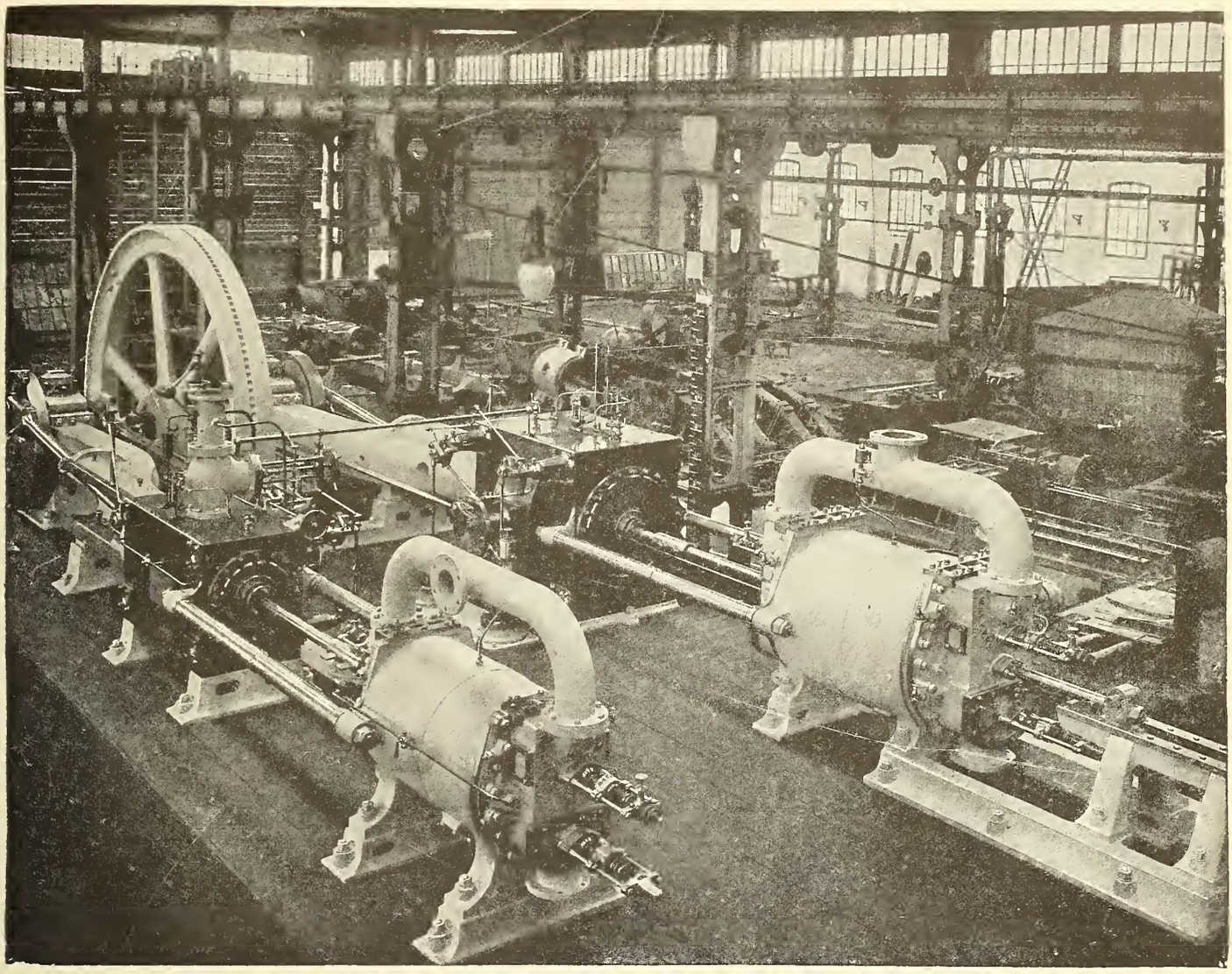
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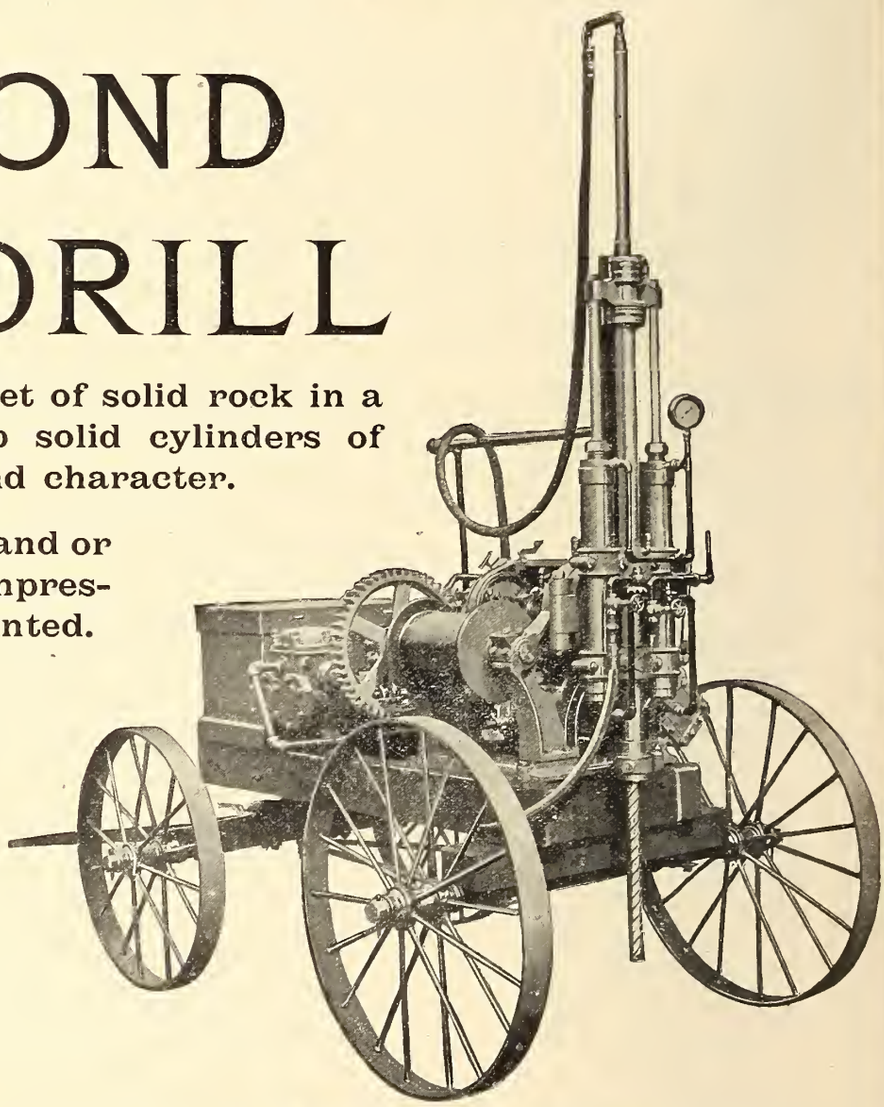
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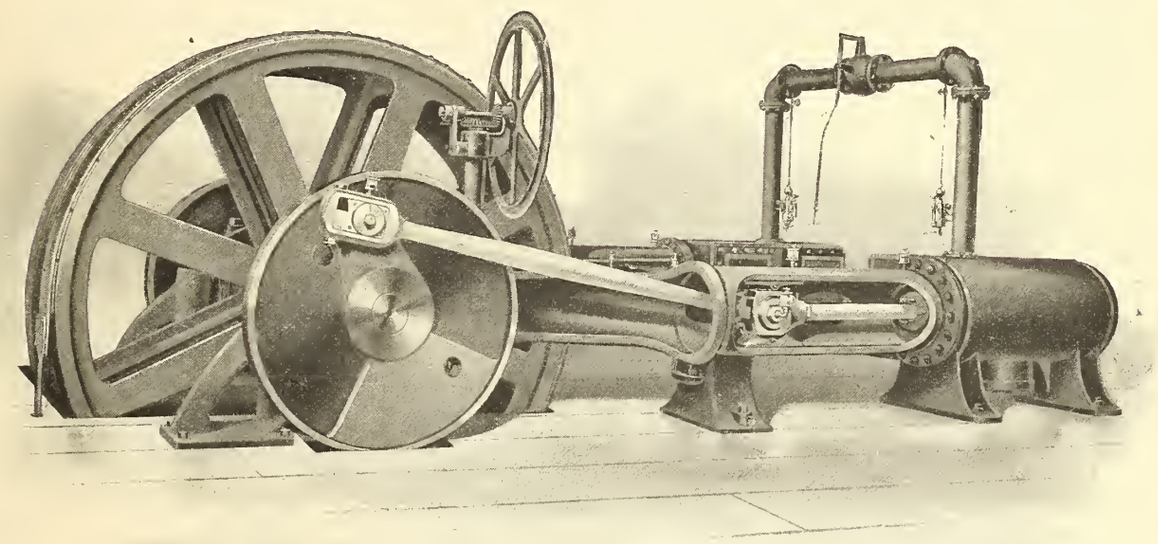
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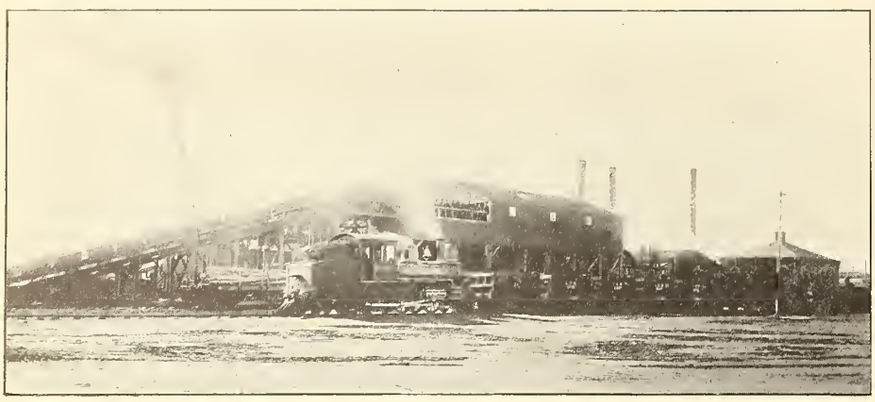
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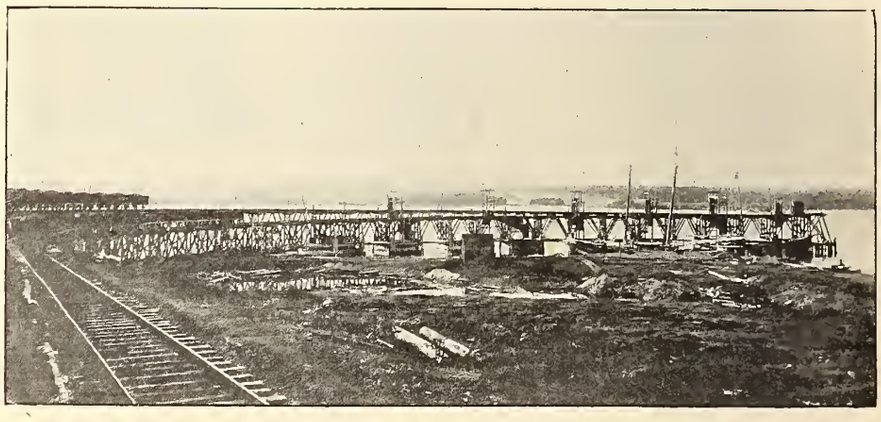
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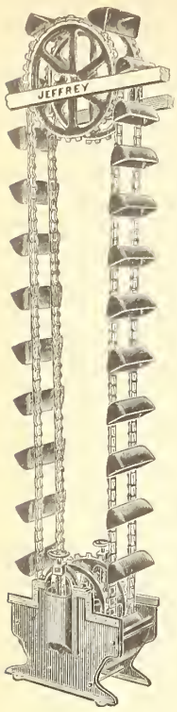
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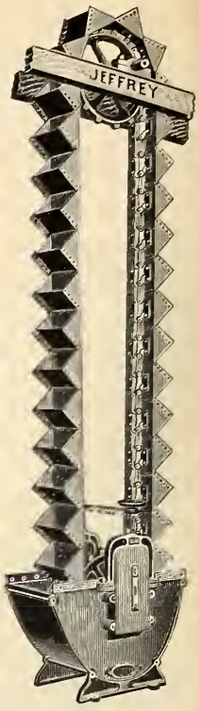
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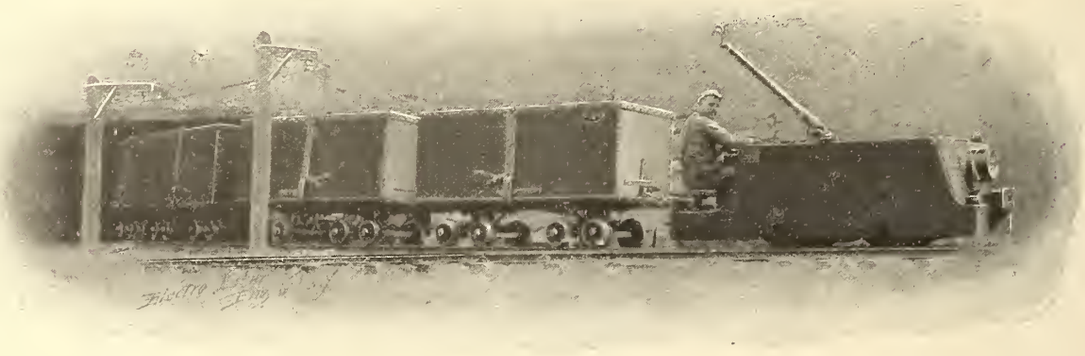
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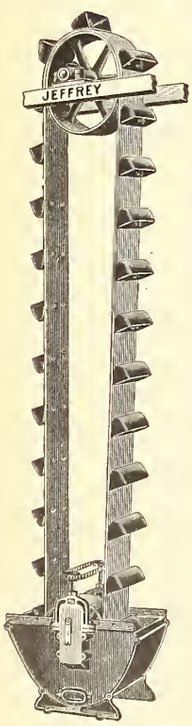
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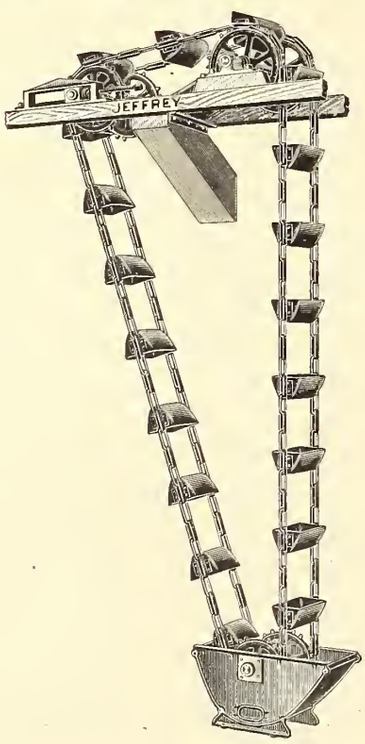
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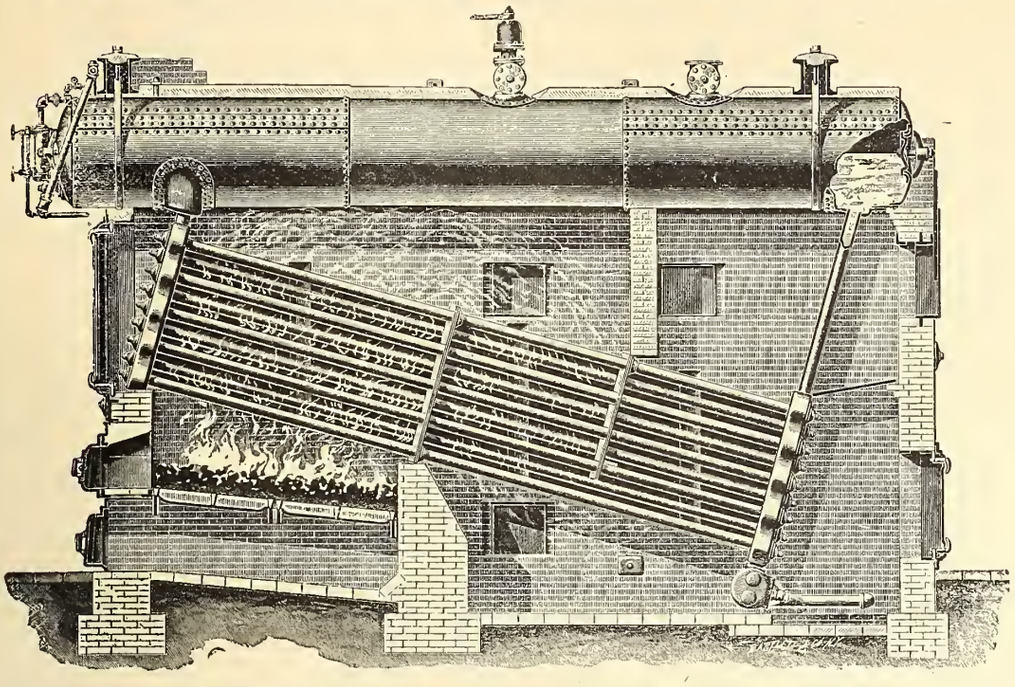


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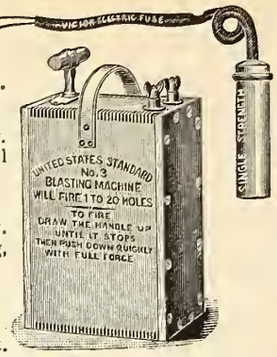
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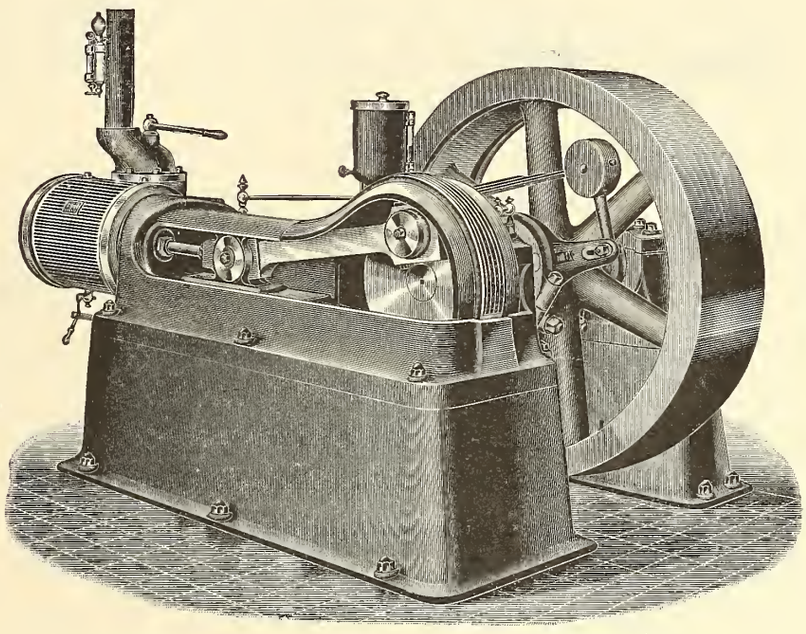
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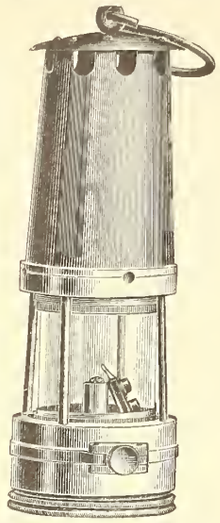
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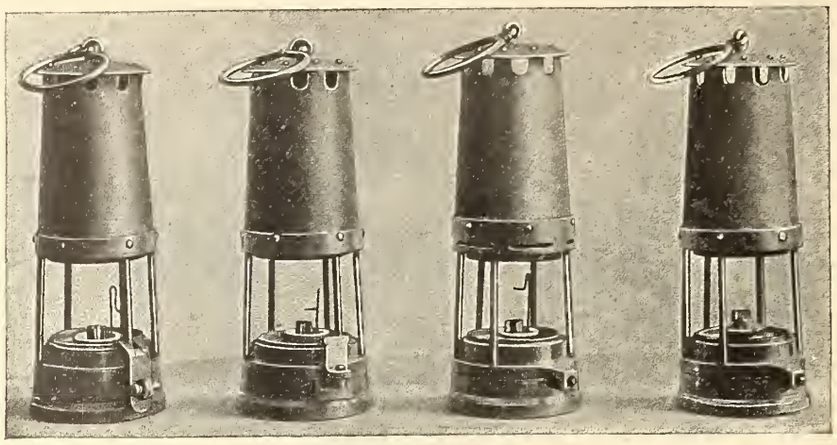
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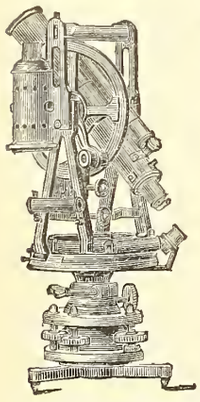


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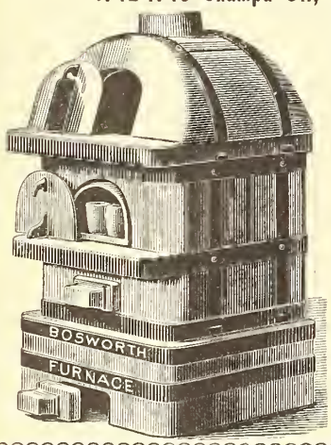
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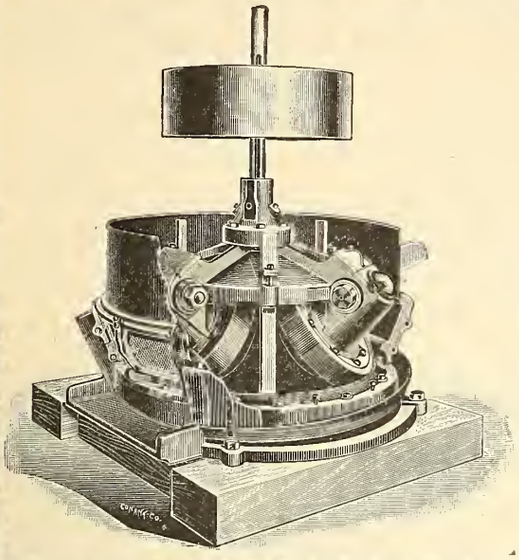
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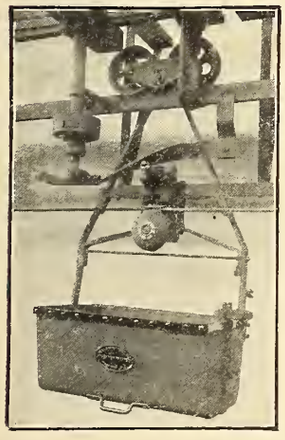
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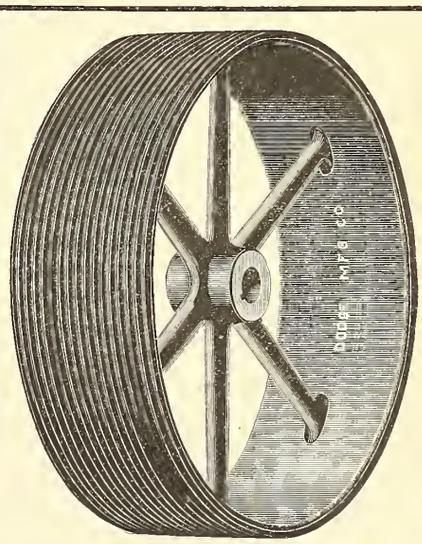
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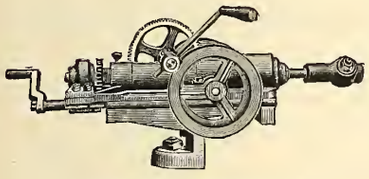
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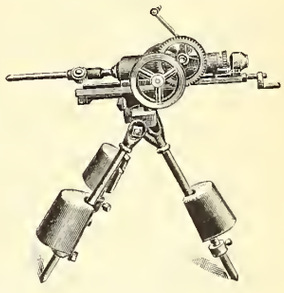
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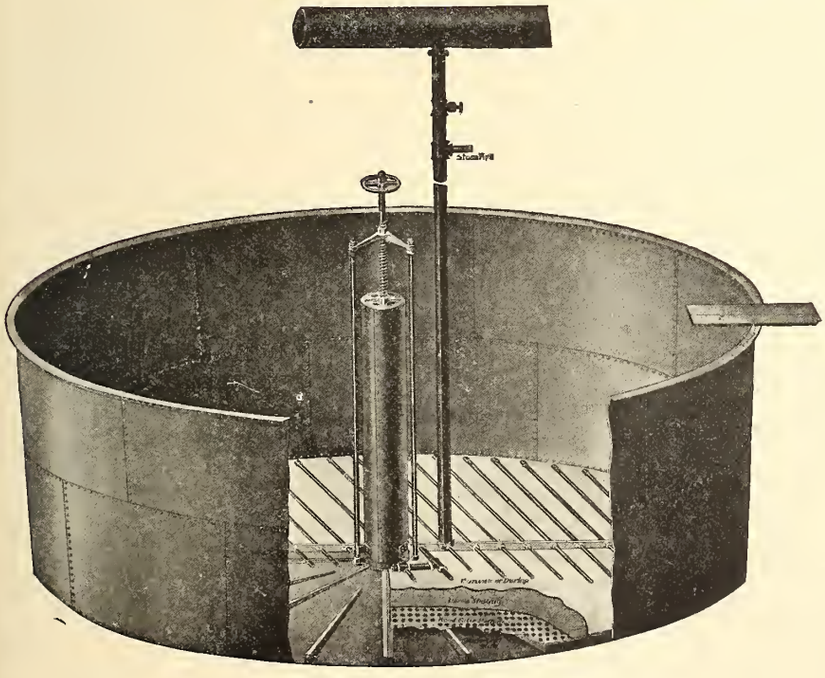


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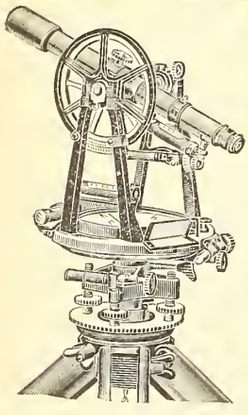
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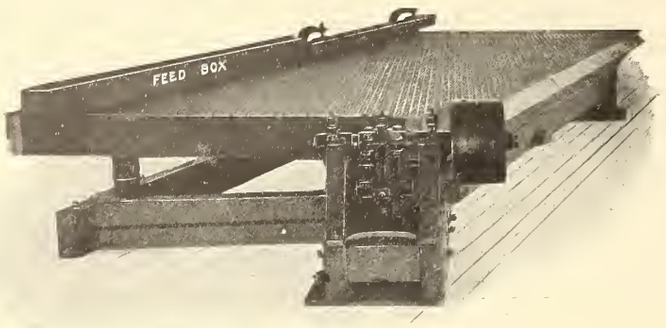
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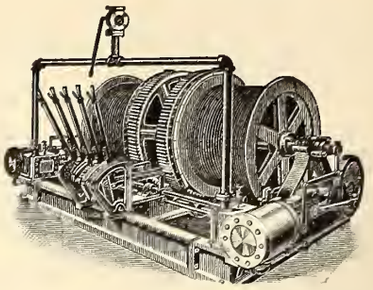
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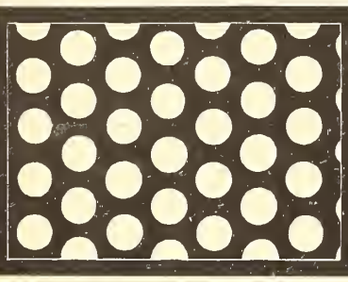
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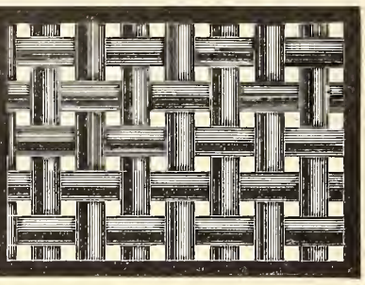
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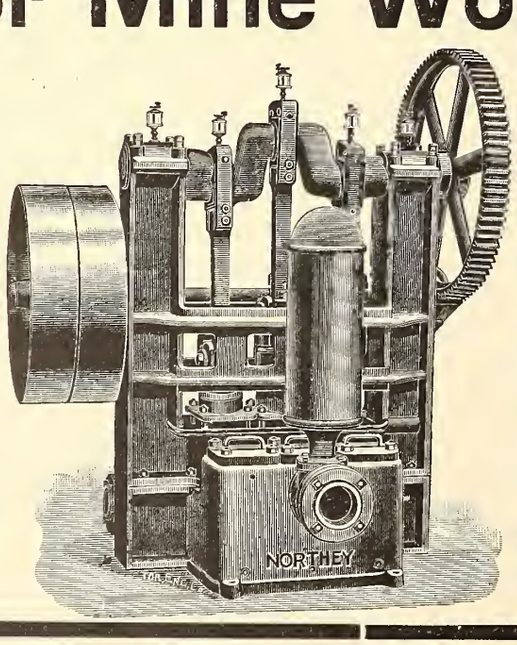
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VOL. XXI., No. 12. DECEMBER, 1902. VOL. XXI., No. 12.

Mica Munchausen.

The prospectus of the Empire Mica Company has come into our hands. It informs us that 'how to found a fortune that will make him independent is the dream of every man's life' and that 'his dreams seldom comes true because he chases rainbows rather than realities.' This introduction suggests the advisibility of examining further into this mica proposition to test *its* realty or *its* rainbow character. As the capital stock is only $500,000 ('forever non-assessable') we must not expect too much. It might have been $5,000,000. But evidently we are not dealing with an ordinary prospectus or an ordinary company. The word *forever* used in describing the character of the stock is evidently no idle word. The eternal verities are here foreshadowed; and a little further on the unique sources of information possessed by this company are plainly declared. We are informed that 'when the Creator made mica he made nothing else that can ever take its place.' Doubtless this was for the especial benefit of the Empire Mica Company. Is it any wonder that a company with such connections benevolently advises prospective investors 'not to wait until the price of one share (at present one dollar) is beyond their reach'? Could they do less than warn their less favored fellow beings that a golden opportunity now present might be lost by delay? But the golden visions of this company have inspired them to a pitch of eloquence rarely reached even in a prospectus. 'All the gold of the Rand, the gems of the diamond fields of South Africa, the precious metals of the Pacific Slope, the wealth that brave men wrench from the frozen fields of the Arctic Circle in a year heaped in one glittering pile.' This is magnificent, and is surely a prelude to a declaration of the incorruptibility of the Empire Mica Co. or of the high esteem in which its officers and directors hold the principles of truth and rectitude! But no! 'This glittering pile would not buy the pig iron production of the world for the same space of time; Pig Iron is dear at $10 to $12 a ton. Mica, like iron, also is a public necessity, and sells in sheets at from $1,700 to $26,000 a ton.' Shades of the immortal Pegleg Bumgarten! Mica and pig iron! The prospectus reminds us, doubtless by way of extenuation, that the word *mica* is derived from a Latin word meaning *to glitter*. That we are correct in this surmise is evident from the next sentence. 'It comes in "books" which split into thin elastic plates. They can be split so thin,'—as to be like the baseless fabric of a dream and vanish into airy nothingness,—but we have been carried away by the spirit of this marvellous prospectus.

The writer of the Empire Mica Company's prospectus has accomplished a task left for him by the great minds of past centuries, the reconciliation of science and theology. He has already shown his familiarity with the latter and that he is equally at home in science will be plain from the following quotations.—'It (mica) is found between granite and flint formations.'—'Between the slate formation and flint and quartz rocks lie the kidneys or "books" of mica surrounded by disintegrated talc spar.'—That 'disintegrated talc spar' is a fine touch. We are evidently in the presence of an artist. This sentence is the masterly introduction to a climax which should take its place with such *chefs d'œuvres* as the prospectuses of The Prodigious Horn Blower Syndicate, The Great Aurora Borealis Gold Dredging and Pearl Diving Company, and the Terahooligan Ananias-Sapphira Corundum Co. Our artist now unveils,—'This formation mekes the Empire Mica Company's mines the cheapest in the world to operate. No expensive mining machinery is needed. No money has to be spent blasting out worthless granite as in other mines. (In this phraseology there is a suggestion of the story of the Pharisee and the publican.) 'Picks and shovels in the hands of unskilled laborers do the whole work. The mine is so rich that every stroke of the pick pays. Every dollar spent in operating brings a least $10 in return. Shares backed by such assets are safe and sure as Government Bonds and many times as remunerative.'

But our friend's scientific knowledge is by no means exhausted. He is a great mathematician,—revelling in figures. Hear him? "You have the figures of Alexander M. Womble, the expert, that the total cost of producing first class mica in our mines and delivering it in New York is $50 a ton. The selling price he quotes is from 40 cents to $8 per pound. This means that you can sell at from $800 to $16,000 a ton a commodity that costs you exactly $50 to produce,—not a cent more. (Here is management! Here is book-keeping for you!)—These prices are for mica now in sight. The veins are richer further down. (They always are, in companies like the Empire Mica!) "We have mica that will sell for $26,000 a ton, earning for the Company a profit of $25,950 on 2000 pounds of product." (!!!). "Such are the profits of this protected industry." He then proceeds to figure out 28 per cent. in dividends the first year on the par value of the $500,000 stock, and promises an output per month of 24,000 pounds of mica of an average value of $3 per pound and 12,000 pounds worth 50 cents a pound, i. e. an annual output of 148,000 pounds of merchantable mica, not including waste. 'Within a few years the output will be increased twenty times, (3,960,000 lbs.!) making the market value of each ten shares $1,120, to say nothing of the dividends you will have drawn in that space of time.'

'Such figures may sound incredible (Oh, no! Not at all!) yet

they have been surpassed (we doubt it!) by many other mining and manufacturing companies that had prospects (misprint evidently for prospectuses?) far less brilliant than the Empire Mica Co. The Carnegie Steel Company was started with a few million dollars. In the latter part of the eighties it had grown so that it was capitalized at $25,000,000, yet it was taken into the Steel Trust at a valuation of $500,000,000, because it paid dividends on that amount of money. Mica is a better paymaster than iron.' This is not arithmetic it is magic! Mica is a better paymaster than iron! Womble *versus* Carnegie! Iron has no chance! But let the Empire Mica champion speak for himself.

"As per your request I have visited and examined the mica property located near the railroad town of Madison, N.C. I found the property to be about 202 acres in extent.

INDICATIONS. The mica indications or croppings show in quite a number of places on this tract of land. It has been mined in two places with open pits. One of these pits is 30 feet by 60 feet, and in one place is 60 feet 60 feet in depth.

FORMATION. The formation in which the mica occurs is from 30 feet to 80 feet in width, and is composed of a disintegrated talcspar (sic!). The mica is found in kidneys or "books" weighing from 5 to 600 pounds each. The foot wall is a quartzite dike and the hanging wall a mica-schist.

At present the mine is in position to produce one ton of first-class mica per month, and from five to six tons of seconds per month. The market price of this mica is from 40 cents to $8 per pound.

DEPTH. There is every indication of this formation going down to a great depth."

This is part of the statement of the Empire Mica Company's consulting engineer, whose name appears on the prospectus, and from whom the writer of the prospectus has evidently drawn deep inspiration. This engineer assures the investing public that the property is *at present* in position to produce $11,650 worth of mica per month from two holes worked with pick and shovel!

But this prospectus is like the Empire Mica Company's property,—a mine of untold wealth,—a Golconda of humour!

Again let us quote:—

"MICA

NOT AN OUNCE IS WASTED.

"P. D. Armour once boasted that on every pig he killed he made a profit on everything except the squeal. Mica is as profitable. Every ounce taken out of the ground can be sold." (!!) [Here let us pause to advise Messrs. Munsell, Blackburn, Wallingford, Kent, and all the other Canadian mica producers that they are away behind the times. Here is news for them.] "Portions that are trimmed off the sheet are worth $20 a ton f. o. b. at the mines or can be ground to powder and sold at from $80 to $120 a ton. The demand for ground mica is unlimited. It is used extensively by wall-paper manufacturers. They cannot obtain the same glitter from any other substance. As a base for fireproof paints it has no equal, nor is it surpassed as a base for lubricants. Another use has been found for it in green houses and conservatories. It is better for that purpose than glass because it does not focus the sun's rays. The supply is still far less than the demand, and were it not so there would be even more uses for this precious mineral.'

This is rich, when considered in the light of the facts that not more than 10 or 15 per cent. of the mica mined can be cut into plates and that all the rest is scrap. When it is remembered, too, that a mica vein yields only an average of about 10 per cent. of mica, and that large quantities of other minerals must be removed along with it, the humour of this prospectus is apparent.

We have another warning to give. Another Canadian industry is in danger. Let our asbestos mining friends take heed. When George Smith reads these lines let him tremble and look for another hole in the ground! Thetford is doomed! 'Mica is woven into cloth, twisted into ropes, and even rolled into paper.'

A few more quotations to show to what heights the imagination soars when attracted by the unexampled glitter of mica.

'Hidden away on Sandy Ridge, a spur of the Blue Ridge Mountains, this priceless treasure of precious mineral has lain for years. Years ago two farmers from Danbury, the county seat, opened up the Joel Hawkins mine and carted the product in rough blocks to Danbury, where they sold $50,000 worth of mica in that State. With the death of these men operations ceased, and the mine was forgotten until an electrical engineer discovered it again in 1898. He re-opened one of the drifts, and took out blocks of mica weighing as much as 600 lbs. On account of his methods *he was compelled to flee the State*, (the italics are ours) but the secret of the rich deposits was out, and this most valuable mica mine was acquired by the Empire Mica Company.'

It is unfortunate that it is very difficult, if not sometimes impossible, under existing laws, to make companies responsible for statements in prospectuses issued by them. Otherwise the Empire Mica Company promoters might have to follow the example of the electrical engineer.

'Our experts prospected the field thoroughly, [How thoroughly appears from the extracts already given.—ED.] with the result that we acquired the entire 202 acres which covers the cream of the district. Every stroke of the pick revealed new richness. Even the experts were astounded by the great, glittering hoard of richness (!!!) nature had stored there for the use of man. It waits only the hand of man to be turned into coin. Everywhere over this immense tract [202 acres!] there are outcroppings of mica which grow richer as it goes down, [When *will* the people get on to this? The very fact of its repeated use in this precious document shows that it can be relied on to bring down unwary birds.], and the depth of mica beds has never been reached. Our mica comes out of the ground ready for the market, clear as crystal, tough and firm.' (!!).

We did injustice to this prospectus at the beginning of this review. It had been only cursorily examined. We put it in the same class with the Terahooligan Ananias-Sapphira Corundum Company's prospectus. An apology is due Messrs. Spotswood, Breese, Bright, Womble & Co. After a more careful perusal, we see that their prospectus is not to be named in the same breath with the nevertheless remarkable flight of the Sapphira Company. The latter is distanced—out of the race. It must now hide its diminished head. But let the Sapphira promoters not be discouraged. Corundum is a dull subject compared with "the great glittering hoard of richness" which nature provided for the inspiration of the Empire mica man.

How long are these things to be suffered? So long as there are fools to be caught by such bait as is thrown out in this Empire mica prospectus. The statements we have quoted do not mislead anyone who already knows or takes pains to learn the facts concerning mica mining and the mica market; and it seems incredible that any man can be caught by such trash. But the whole thing is an appeal to cupidity, and the desire to get something for nothing is very common and very powerful. It is probably not unfelt even in the ranks of the officers and directors of the Empire Mica Company, whose "shafts show $134,333.33 worth of mica in sight," "getting richer as it goes down," "no salaries to pay," &c., &c.

Such companies are parasites on legitimate mining enterprises; and this brazen attempt to induce "small investors" to buy shares so that "the poor man may get the use of the capitalists' business training and acumen free," is on a par with the rest. These promoters ask for money to develop and equip a mine which they state *at present*

to be in position to produce $12,000 worth of mica per month! And in the same breath they state that this mine needs no machinery—pick and shovel do it all!

Mica mining is a legitimate business yielding good profits; but everyone who has engaged in it knows how uncertain the deposits are. The value of the mica depends to a great extent on a clean and perfect crystallisation. This is so often absent, that it is quite exceptional to find continuous masses of good mica, and even when the mica taken out is merchantable, only a very small proportion of it cuts to the larger sizes. The proportion bringing $5 or $6 a pound is quite insignificent, and indeed the demand for the larger sizes is quite limited. The vein or dike matter, too, is quite complex. The mica is only one of several chief constituents, and its distribution is uncertain and irregular. These causes account for the huge dumps of waste mica and other rock to be seen about mica mines and trimming works which have been in operation for any length of time. The Empire Mica Company's 80 foot dike might contain 10 per cent. of mica, and of this 10 or 15 per cent. might be merchantable, although the percentage might be much less. There is a demand for a small quantity of the waste, (quite trifling in comparison with the quantity produced), for boiler covering and grinding. But the waste suitable for these purposes must itself be selected, and it brings only a few dollars a ton at the mine. The chief factor in the big figures quoted by the Empire Company is in the manufacture.

These are a few of the cold facts to be set over against this most amazing attempt to bleed the unsuspecting public. But they are hardly necessary. The prospectus speaks for itself.

The Centre Star Report.

We are indebted to the courtesy of the Secretary of the Centre Star Mining Company for a glance at the fourth annual report of the Company submitted to the Annual Meeting of Shareholders on the 25th ultimo.

In its general form and in the amount of explicit information (?) afforded to shareholders this document conforms to previous reports and is notable chiefly for the statement with which the General Manager opens his annual account of the condition of the property, viz:—"The condition of the Centre Star mine has much improved during the past year."

The accounts submitted show, on their face, a loss for the year just closed of $77,560.54; the Profit and Loss Account gives some details from which on one learns that the actual loss for the year amounted to $107,981. The total costs for the year were $225,776.43 from which the amount of deprecation written off ($29,836.53), and the net sum realized from Ore Sales ($87,957 91), if subtracted would leave a debit balance of $107,981.99. In addition the sum of $60,128 which was the cash balance remaining on October 1st 1901, has also disappeared. Against this very poor financial showing we have the assurance of the General Manager that the condition of the mine has much improved.

From Mr. Kirby's report, the only source of information available to the public, it appears that all payable reserves above the 4th. level have been taken out; that between the 4th. and 5th. levels the ore averages (from assays given) rather below, than above, $9.00 per ton; that between the 5th. and 6th. levels values are not over $5.00 per ton; that between the 6th. and 7th. levels there is a length of about 30 ft. with a width of about 7 ft. that will assay $5.80; and on the 8th. level there is a suspicion of $16.00 ore somewhere near, although the detailed account shows only $3.80 value. This occurs at the depth of 1077 ft. and below this depth to the bottom of the shaft (1289.6 ft.) no values are reported, but the grade is said to be "low."

As a guide to the values reported above we may state that the costs of mining are given at $3.00 per ton ($2.93) and the freight and smelting charges at $5.22 per ton; a total cost of $8.15 per ton.

The only inference to be drawn from the facts the Report gives is that values decrease rapidly below that 5th level, and that the last 600 ft. in depth on the vein are not productive of payable ore. This inference is in harmony with the information recently received by The Review from a gentleman who has been resident in Rossland for five or six years. The better informed local authorities have, for some time, known that the payable portion of the Centre Star Chute was dipping into Le Roi ground, and Mr. Kirby's published figures appear to sustain their views.

The dip of ore chutes in the plane of an ore deposit is, of course, well known and always expected by mining men. The diminution of values in the Centre Star vein below the 5th. level, and for a distance of at least 600 feet, show that the second pay chute (if there is a second) is a very considerable distance from the first, and that expensive and extensive exploration work may be expected by Centre Star Shareholders until it is discovered,

The favorable feature of the report is contained in Mr. Kirby's positive statements of the success he has had in concentrating the lower grades of ore. That a successful method of treating low grade ores has been devised, that the difficulties of such treatment have been overcome, and that a regular tonnage of these low grade ores will soon be under treatment, are cheering items to shareholders; let us hope that Mr. Kirby has not deceived himself. We have long been of the opinion that the permanent future of Rossland Camp depended on the successful solving of the concentration problem, and we heartily hope that Mr. Kirby has solved it; but lest undue exaggeration should arise from mis-conception of *all* of the facts, The Review may be permitted to remind speculators that the cost of mining *alone* ($3.00) will inhibit the revival of many old local companies, and that, taking into account all costs, with the uncertainty of water supply and high transportation rates, it is altogether unlikely that ore, of a less net assay value than $4 00 per ton, can be available for concentration; a less value would make a deficit rather than a surplus.

Is Liquid Pig Iron Pig Iron?

On 5th instant an important judgment of the greatest interest to the Canadian iron and steel industries was tendered by Judge Burbridge, in the Exchequer Court of Canada, in the matter of the Petition of Right of the Dominion Iron and Steel Company, Limited and His Majesty the King. The action was to secure from the Dominion Government the sum of $196,967.15 for bounties on pig iron and steel ingots manufactured by the Steel Co., which it claimed to be entitled to by virtue of the provisions of the Acts of Parliament 60-61 Victoria, Chapter 6 and 62 63 Victoria, Chapter 8, and of the regulations made under such Acts. The defence of the Government was that a portion of the iron on which the bounty was claimed was used in a molten or liquid state for the manufacture of steel ingots, and that in this form it was not pig iron within the meaning of the statutes referred to. In his judgment of which the appended is a *verbatum* copy Mr. Justice Burbridge says:—

"The first Act passed in Canada to encourage the manufacture of pig iron to which my attention has been called was passed in the year 1883. By this Act (46 Vict. c. 14) the Governor in Council, under regulations to be made by him, was authorized to pay out of the Consolidated Revenue Fund a bounty on all pig iron manufactured in

in Canada between certain prescribed dates, the bounty to be one dollar and fifty cents per ton where the pig iron was made from Canadian ore, and in other cases one dollar per ton. By the Act 49th Victoria, Chapter 38, the time within which such bounties could be earned was extented. In 1890 the bounty on pig iron manufactured from Canadian ore was increased to two dollars per ton (53rd Victoria, Chapter 22). Up to this time the bounties were offered to encourage the production in Canada of pig iron, and especially of pig iron manufactured from Canadian ore. In 1894 a further step was taken, and bounties were offered for the manufacture in Canada of iron and steel from Canadian ore. By the Act of that year 57-58 Victoria, Chapter 9, the Governor in Council was authorized to pay a bounty of two dollars per ton on all pig iron made in Canada from Canadian ore, and a like bounty on puddled iron bars made in Canada from Canadian ore, and on steel billets manufactured in Canada from pig iron made in Canada from Canadian ore and such other ingredients as were necessary and usual in the manufacture of such steel billets, the proportion of such ingredients to be regulated by order of the Governor in Council. By the Second section of the Act it was provided that in the case of the products of furnaces then in operation the bounties should be applicable only to such products as were manufactured therein between March 27th, 1894 and March 26th, 1899; and that in the case of any furnace which should commence operations thereafter and before March 27th, 1899, such bounties should be applicable to the products manufactured therein during a period of five years from the date of commencing operations. None of these statutes are directly in issue in this case, but they have been mentioned to show what preceded the statutes on which the question to be determined turns, and as showtng a general intention of Parliament during the years mentioned, not only to stimulate the production of pig iron by furnaces then in existence, but to encourage the erection of other furnaces for that purpose and for the purpose of manufacturing such pig iron into puddled iron bars and steel billets.

"Coming now to the first of the two statutes under which the present claim arises, it will be seen that by the first section of the Act (60-61 Victoria, Chapter 6) it is provided as follows:—

> "1. The Governor in Council may authorize the payment of the following bounties on steel ingots, puddled iron bars and pig iron made in Canada, that is to say:—
>
> On steel ingots manufactured from ingredients of which not less than fifty per cent of the weight thereof consists of pig iron made in Canada, a bounty of three dollars per ton;
>
> On puddled iron bars manufactured from pig iron made in Canada, a bounty of three dollars per ton;
>
> On pig iron manufactured from ore, a bounty of three dollars per ton on the proportion produced from Canadian ore, and two dollars per ton on the proportion produced from foreign ore."

The second section of the Act prescribed the time within which such steel ingots puddled iron bars, and pig iron should be made in order that the bounty might be earned; and the third section gave the Governor in Council authority to make regulations in relation to such bounties and to carry out the intention of the Act. By the Act 62-63 Victoria, Chapter 8, the time mentioned in the second section of the Act 60-61 Victoria, Chapter 6, was extended, and a gradually diminishing scale of bounties prescribed; and it was also provided that no bounty should be paid on steel ingots made from puddled iron bars manufactured in Canada. A bounty could be earned on pig iron, and then on either on puddled iron bars or steel ingots made therefrom; but the manufacturer could not earn a third bounty by making the puddled iron bars into steel ingots. In the manufacture of iron and steel from the ore two bounties, but not three, might be payable with respect to the same material in a different form or state of manufacture. The regulations made by the Governor in Council respecting the payment of such bounties are in evidence, but no question arises thereon which does not equally arise upon the statutes under which they were made, and it is not necessary to refer more particularly to these provisions.

The company has, at Sydney, Cape Breton, four blast furnaces for the manufacture of pig iron, and an open hearth steel plant consisting of ten "H. H. Campbell Tilting Open Hearth Furnaces" for the manufacture of steel. The construction of these furnaces was commenced in the year 1899, and they have since been completed at a great cost and are now in operation. Part of the product of these blast furnaces is cast in a sand bed in the usual way; part is run in moulds that form what is called the pig machine; and a part is conveyed in a molten or liquid state from the blast furnaces to the steel mill and is there poured into a mixer or reservoir for holding this liquid metal, and from which a supply is drawn whenever a charge is required for one of the steel furnaces. The liquid metal is taken from the blast furnaces to the reservoir in large ladles set on trucks, and are moved by an engine on an ordinary railway track. While in these ladles the metal is weighed. That may be, and is done with convenience and accuracy. This practice of taking the metal in a liquid state from the blast furnaces direct to the steel plant was not in 1899 or in 1897 a new practice or process in the manufacture of steel from pig iron. As shown by Mr. Chrysler the practice has been followed for a number of years in almost every country in which iron and steel is manufactured. It has been followed in the United States, in Great Britain, in Sweden, in Germany, in Belgium, in France, in Austria, in Hungary, in Russia, in Syria and in Japan. And although this practice has in general been adopted only in cases where the blast furnaces and steel plant were under the same management, the evidence discloses a few instances in which a manufacturer of pig iron has sold part of the product of his furnaces to another manufacturer of iron or steel and delivered it to him in a molten or liquid state. Of course that is only possible within limits. The blast furnaces and the steel plant must be near enough to each other to permit of the ladles being moved from the one to the other without giving the metal time to cool.

There is no controversy about that portion of the product of the company's furnaces that is cast in the sand bed or run into the pig machine. The question in issue is raised in respect of the metal that is taken in a liquid state from the furnaces to the reservoir or mixer. As to that it is argued for the respondent that this metal in this state or condition is not pig iron within the meaning of the statutes, that have been referred to; and that no bounty is payable in respect thereof or in respect of the steel ingots manufactured therefrom. That is the question to be determined.

But before coming directly to that question it may perhaps be found convenient to refer to some rules that have been laid down to guide in the construction of terms occurring in Acts of Parliament. And with respect to statutes generally I do not know that I could do better than to adopt the language used in *Maillard v. Lawrence* (16 How. 261) where it is said that the popular or received import of words furnishes the general rule for the interpretation of public laws, as well as of paivate and social transactions, and wherever the Legislature adopts such language to define and promulgate its action or its will the just conclusion must be that it not only comprehended the meaning of the language it has selected but has chosen it with reference to the known apprehension of those to whom the language is addressed, and for whom it is designed to constitute a rule of conduct, namely, the com-

munity at large. That is a general rule. But in the case of tariff laws it has been held that in imposing duties the legislature must be understood as describing the articles upon which the duty is imposed according to the commercial understanding in the markets of the country of the terms used in the statute. The commercial designation, the use of the term by merchants and importers, is in such cases the first thing to be ascertained. *Arthur v. Morrison* (96 U. S. R. 108); *Robertson v. Salomon* (130 U. S R. 413); *Nix v. Hedden* (149 U. S. R. 304). And where a term has not acquired any special meaning in trade or commerce it is to be taken and received in its ordinary meaning in the common language of the people. In the present case we have to deal with statutes that must, I think, be taken to be addressed in the first instance to manufacturers of iron and steel. It is to them that the bounties prescribed are offered. And while persons engaged in other branches of the same industry or in other industries, as well as the community at large have an interest in the matter, it does seem that any enquiry that would leave out of account the meaning attributed by such manufacturers to the terms used in such statutes would be incomplete and might be misleading.

Pig iron is the product of a blast furnace used for the purpose of reducing iron ores. It contains, among other things a larger proportion or percentage of carbon than either steel or puddled iron bars. And one of the principal objects to be attained in the manufacture of steel ingots or puddled iron bars from pig iron is to get rid of this excess of carbon. The term, "pig iron" was derived from the shape which the iron assumed in the sand beds in which it was first cast; and when first used had reference no doubt to a particular shape or form. It has since acquired a larger meaning, and as used at present includes, it is conceded, any product of the blast furnace that is cast in any convenient form or shape without reference to what that form or shape may be. So far the parties to the present controversy are agreed. It has also happened that among ironmasters and those who are familiar with the processes by which iron ores are reduced and made into pig iron and then manufactured into wrought iron or steel, that the term "pig iron" has come to mean and include as well that substance in a molten or liquid state, it being usual to prefix to that expression some edjective such as "molten" or "liquid" when the speaker or writer wishes to distinguish between solid pig iron and liquid pig iron. But as in the nature of things diffculty and expense are involved in maintaining iron in a liquid state, and as there is in general no object in overcoming the difficulty or incurring that expense except for an inconsiderable length of time, most men see pig iron in a solid form; and that form is in general necessary to the handling of it as an article of trade and commerce. So it must, I think be conceded that in common speech the term "pig iron" carries with it the meaning of something that is solid and not liquid. If one turns to the dictionaries to ascertain the meaning of the term he will, I think, come away from the enquiry with the same impression. That of course may be because one lexicographer follows another and does not make the original research into the modern literature of the subject that Mr. Chrysler has with such great industry made. Of the result of his researches of which I have had the advantage, it is not possible with fairness to his argument and a proper regard for brevity, to make any present use further than to say that I do not think anyone sitting down to make a new dictionary from original sources, and reading the extracts Mr. Chrysler read, would adequately interpret the term "pig iron" if he failed to make it clear that the term is now, and has for a considerable number of years been used in a sense that includes that metal in a liquid as well as in a solid state. And if the only question were whether the metal which the company used in a liquid state for the manufacture of steel ingots was or was not pig iron, there could I think be only one answer to the question, and that is, that it was pig iron But the question is somewhat narrower than that. Perhaps it would be more exact to say that there are two questions, and that one of them is narrower than that stated. With regard to the bounty on steel ingots that may be the question. Were or were not the steel ingots in question made from pig iron? With regard to bounty on pig iron the question is not perhaps whether liquid pig iron is pig iron, a question that suggests its own answer, but whether it is pig iron on which a bounty is payable under the statute? The steel ingots in question were undoubetedly steel ingots within the meaning of that term as used in the statute. There is no dispute about that; and they were manufactured from ingredients of which not less than fifty per cent of the weight thereof consisted of something made in Canada, and when one asks what that something was there is only one answer possible, namely that it was pig iron used in a molten or liquid state, but none the less pig iron; for as to that there is nothing to suggest that it can make any difference in what form or condition the pig iron was when so used. If the pig iron as it came from the blast furnace had been allowed to cool it would have been necessary to melt it before it could have been used in the further process of making steel. If it were suggested that the manufacturer who used the liquid metal for making steel has an advantage over one who is not in a position to do so, and that the latter would for that reason be placed in respect of the bounty in a position of inequality, the answer is that the statute does not disclose any intention on the part of Parliament, in any way to equalize the conditions under which different manufacturers would earn the bounties in question. I do not know that anyone could properly attribute any intention to Parliament, except that it was its intention to encourage the manufacture in Canada of pig iron, puddled iron bars and steel ingots; and the erection in Canada of furnaces and mills in which these things would be produced. But if one were to go beyond that and speculate as to matters not appearing upon the face of the statute it would, I think, be reasonable to conclude that Parliament intended (if as to that it intended anything) to encourage the erection of furnaces and mills using the most modern, efficient and best appliances and processes known to the trade or business. but for myself I am not sure that Parliament intended anything more than to leave each manufacturer to carry on his own business and to earn the bounty in his own way. All I do say is that I do not see anything in the statute to lead me to the conclusion that Parliament intended to handicap progress and economy in the art of making iron and steel by witholding the bonuty on steel ingots manufactured from liquid pig iron in the manner described.

But when one has said that the company has earned and is entitled to the bonnty on the steel ingots that it has made from such pig iron it does not follow as a matter of course that it has also earned and is entitled to a bounty on the pig iron itself. That, as has been stated, raises in some of its aspects a different question. The pig iron, the product of the blast furnace, is as much pig iron while it is in the blast furnace as it is when it has been run off into the ladles; but no one would suggest that the manufacturer could, with any hope of succeeding, say to the Governor in Council, here are my blast furnaces full of pig iron, pay me the bounty on the pig iron. The answer would no doubt be, if it is pig iron it is not in the state or condition in which a bounty is payable on it. Something more must be done. The amount of the bounty is to be determined by reference to the number of tons of pig iron produced. The pig iron must be weighed. It must also, I think be something that can be used. Not that any one to earn the bounty must make use of it, but no bounty is, it seems to me, payable in respect of any pig iron that cannot be put to some use. That ought I think to be implied. The bounty is payable on pig iron

manufactured in Canada from ore. The pig iron must be weighed before any bounty is payable, and it must be in a state or condition in which it can be used. These, it seems to me, are the conditions to be observed to entitle the manufacturer to this bounty. Has the suppliant observed them? I think it has. As stated the material produced is pig iron. There is no difficulty in weighing it while in the ladles. It has in fact been carefully weighed. In the molten state in which it then was it was fitted for one of the uses pointed to in the statute, itself, namely, the manufacture of steel ingots. It was used for that purpose, and in my judgment the company was entitled to the appropriate bounty prescribed by the statute.

But before leaving the subject I ought to add that I have not overlooked two arguments against the view that I have expressed, to which I have as yet made no reference. It is said that in the early statutes, when the bounty was confined to pig iron, that term meant what was known generally and commonly as pig iron, and possibly that may be so. And then it is said that the same term used in the later statutes must be taken to have the same meaning and not a wider one. Some weight no doubt is to be given to that consideration, but it is not conclusive. Other considerations are involved. Then it is said that the term used in the French version of the statute namely "le fer en gueuse" shows that it was the intention of Parliament to confine the bounty to pig iron having some shape; and that if it had been its intention that it should also be payable on pig iron used in a liquid state for the manufacture of puddled iron bars or steel ingots there was not wanting a more appropriate term such as "le fer fondu" to give expression to that intention. That too, is an argument entitled to consideration, but again it is not conclusive, if, as I think, the larger meaning is to be gathered from the statute as a whole. And as to that it does seem to me that Parliament was dealing with a substance or material, and was not particularly concerned with its shape or form or condition, so long as it was pig iron and could be weighed and put to some use; and with respect to the uses to which it could be put a special encouragement by way of a bounty was offered to any manufacturer who would use it to manufacture in Canada seel ingots or puddled iron bars, and I do not think that it was intended to draw any distinction between its use in a solid or in a liquid state. The suppliant is in my opinion entitled to the relief sought by the petition. The amount claimed is as stated, one hundred and ninety six thousand nine hundred and sixty seven dollars and fifteen cents ($196,967.15) and no question was raised as to the amount. But that an opportunity may be given to make that matter more certain, if there is any question about it, the judgment will be entered for the sum mentioned, and costs, with leave to either party to move to strike out the sum so stated and to substitute therefor such an amount as the company may on further enquiry be found to be entitled to."

It is greatly to be regretted that space forbids the publication of all the data furnished by this interesting action. The argument of Mr. F. H. Chrysler, K.C., who so brilliantly conducted the case for the Steel Company is in itself a complete compendium and review of the technical literature and modern iron and steel metallurgical practice. Then there is the evidence of Mr. David Baker, Mr. Graham Fraser, Mr. A. J. Moxham and the other practical men who were examined at length before the Court at Sydney, and the testimony of such eminent metallurgical experts as H. M. Howe, Prof. Richards, J. M. Swank, Julian Kennedy, Wm. P. Snyder, Frank B. Thompson and others, taken before a Commission at Philadelphia, Pittsburg and Cleveland, the whole constituting a most valuable work of reference to the metallurgy of iron and steel. We understand the question of publishing this data is now before the Council of the Canadian Mining Institute.

The Expansion of Our Iron Industries.

The figures published by the Dominion Government in the Trade and Navigation Returns bear testimony to the progress Canada is making in the production of iron ore and pig iron, and the expansion of her iron and steel trade.

While the figures for the year just closing are not yet completed, we find by a reference to the returns given for the past ten months that our mines exported during this period 401,252 tons of iron ore of an estimated value of $996,254, as compared with shipments in the twelve months of the previous year aggregating 306,244 tons, of a value of $774,673. Our exports of pig iron also show a considerable increase; ten months shipments being recorded at 73,371 tons, of a value of $784,506, as compared with 57,600 tons shipped in the whole of 1901. The exports of our manufactures of iron and steel also show a largely increased trade. For the benefit of our readers interested in these growing industries, we take pleasure in reproducing the figures, compiled by THE REVIEW from the Government returns showing the exports.

IRON ORE EXPORTS 1903.

Month	Great Britain		United States		Total	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
January	3,800	$5,800	.....	.....	3,800	$5,800
February	....	.....	30	$67	30	67
March	.....	.....	.....	.....	...	.....
April	.....	.....	26,458	66,525	26,548	66,525
May	.....	.....	148,263	369,880	148,263	369,880
June	.....	.....	96,099	239,505	96,099	239,505
July	.....	.....	12,577	30,896	12,577	30,896
August	.....	.....	33,440	83,008	33,640	83,608
September	.....	.....	36,275	89,646	36,275	89,646
October	.....	.....	44,110	110,327	44,110	110,327
	3,800	$5,800	397,252	$989,854	401,252	$996,254

NOTE.—There were also exported to other countries 200 tons of a value of $600.00.

PIG IRON EXPORTS 1902.

Month	Great Britain		United States		Total	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
January	10,166	$86,920	37	$809	10,203	$87,729
February	3,800	33,000	20	560	3,820	33,560
March	4,260	42,600	3,347	34,311	7,607	76,911
April	16,295	164,050	.....	.....	16,295	164,050
May	13,470	137,165	3,135	34,958	16,647	172,752
June	.....	.....	4,170	43,193	4,170	43,193
July	25	800	2,192	42,653	2,217	43,453
August	2,000	20,000	1,522	16,105	3,522	36,105
September	112	3,090	1,300	17,056	1,467	21,616
October	5,488	78,266	1,935	26,871	7,423	105,137
	55,616	$565,891	17,658	$216,516	73,371	$784,506

NOTE.—During this period there were also exported to other countries 97 tons, valued at $2,099.00.

Imports of Mining Machinery.

The imports of mining machinery for October amounted to $61,396 of which $57,011 were brought in under the Free List and $4,485 subject to duty. Of this amount the United States contributed $58,923 and the balance came from Great Britain. The total imports therefore, for the ten months of the present year aggregate $737,410, the great bulk of which, as shown by our last issue, came in under the Free List. Our statement last month did not include Diamond Drills, which are, excepting the machinery for motive power, admitted duty free. For the ten months we find that the free portions of the Diamond Drilling machinery entered in the Custom's returns amounted to $14,194. The whole of these Diamond Drills were imported from the United States.

Exports of Canadian Asbestos.

The following returns compiled by THE REVIEW from the Monthly Statements of the Department of Customs, show the exports of Canadian Asbestos during the ten months ended 31st October last. As pointed out in a recent issue of THE REVIEW, this industry, which is confined to the Eastern Townships of the Province of Quebec, has been for many years one of the most prosperous of the mining industries of the Dominion. About three thousand persons are employed in the mines and mills, and all the properties of any consequence are earning handsome profits for their owners. The returns show that the year now closing will rank among the most successful since the industry was established in the early eighties.

	Great Britain		U. S. A.		Germany		Other Countries		Total	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Jan. ..	229	$23,705	1,190	$40,455	100	$2,985	40	$860	1,559	$68,005
Feb ..	51	460	1,387	44,669	92	3,360	36	5,480	1,566	53,969
Mar ..	155	5,495	1,713	49,322	.....	.... .	141	5,363	2 009	60,180
April .	221	6,895	1,950	57,168	39	3,120	190	10,725	2,400	77,908
May .	948	46,550	910	31,275	117	1,945	48	5,610	2,023	85,380
June ..	100	1 750	3,234	80,153	17	263	55	3,855	3,406	86,021
july ..	116	5,701	1,264	34,945	69	1,505	269	8,585	1 718	50,716
Aug ..	....	.....	4,097	112,842	.....	.....	312	12,960	4,409	125 802
Sept ..	230	3,450	2,383	72,085	70	1,500	.....	.....	2,683	77,035
Oct. ..	632	32,985	2,184	67,6 8	535	8,612	124	3,300	3,475	112,525
Total	2,682	$126 991	20,312	$590,522	1,039	$23,290	1,215	$56,738	25,248	$797,541

During the same period in 1901 the exports amounted to 18,108 tons, of an estimated value of $428,397; the total exports for the twelve months exceeding 40,000 tons, of a value of about a million and a half dollars. Judging by the returns published above, the year 1902 is to take rank as the banner year in the history of asbestos production in this " or any other " country.

During the fiscal year, ended 30th June last, the figures given by the Trade and Navigation Returns show the exports to have been :—

To	No. I.		No. II.		No. III.	
	Tons	$	Tons	$	Tons	$
Great Britain....	867	119,888	507	23,865	2,714	57,721
Belgium	315	29,600	112	4,062	400	8,250
France	239	25,490	56	3,330	70	1,425
Germany	285	33,605	367	14,836	1,618	41,427
Italy.....	173	15,540	33	2,150	263	6,250
United States....	1,630	144,860	1,284	48,948	22,139	549,955
Total.....	3,509	368,983	2,359	97,191	27,204	665,028

It is worthy of remark that the production of this mineral in the United States during 1901 amounted to only 747 short tons, valued at $13,498, as compared with 1,054 tons, valued at $16,310, in 1900, and 681 tons, valued at $11,740, in 1899.

New and varied uses are constantly being devised for asbestos. Where it is used as an ingredient in fireproof paints, for wall plaster, as boiler coverings, as packing in the manufacture of fireproof safes, and for nearly all purposes in which nonconductivity of heat and not strength of fiber is the important factor, the amphibole variety can be used. On the other hand, where strength of fiber is an essential quality as well as nonconductivity of heat, it is the chrysotile variety the product entirely of Canada, that is used, as in the manufacture of cloth, rope, felt, boards, tubes, washers, blocks of various shapes, etc.

In the periodical Stone, for February, 1901, there was described a test, made by the British Fire Prevention Committee, of the fireproof material called gypsine. This material is composed of plastic hydraulic lime, sand, and asbestos compressed into bricks. In testing its fire-resisting properties, a partition 10 feet long by 7 feet, 9 inches wide was built of gypsine bricks laid in hydraulic mortar, with joints a quarter of an inch thick. The side of this partition, which was erected in the test hut, after having been coated with a thin layer of fire clay, was exposed for the space of one hour to a heat which arose during that time to 2050° F. This high temperature had no effect on the gypsine bricks, and throughout the test the temperature of the outer surface of the partition was never sufficiently high to cause the ignition of a match.

Our Pyrites Deposits.

This is a mineral to which prospectors have given comparatively little attention; and yet, as a source of sulphur for the manufacture of sulphuric acid, sulphite &c., it is of great importance. Formerly native sulphur was used almost exclusively for such manufactures, but the limited supply and the growing demand have driven up the price to and beyond the point at which it pays to use iron pyrites. The production of sulphur in the United States in 1901 was 7,690 short tons, and during the same year 175,210 long tons were imported. In the same year the United States produced 234,825 long tons of pyrites and imported 403,706 tons. During the eleven years 1891 to 1901, pyrites displaced sulphur for the manufacture of sulphuric acid to the extent of about 200 per cent. The value of the pyrites imported by the United States in 1901 is $1,415,149. The major part of it is used in making paper pulp by the acid sulphite process. Here is where this matter concerns us. Canada is destined to become—is becoming,—the great pulp producer for the world. As spruce forests are known to be of great extent, and as exploration is extended and made more minute new areas are being discovered. We are also well provided with waterways for transportation, and with water powers to drive mills. It is not so generally known that we have valuable deposits of pyrites. Those Canadians who are interested in pulp-wood lands should make it their business to keep the ownership of these deposits in the country. Our enterprising neighbors in the United States have already secured some of the largest and most easily accessible bodies of pyrites in Ontario and Quebec, and in most cases are shipping the mineral across the border for the manufacture of sulphuric acid. It may come to be a repetition of the old story of the pulp-wood of Ontario, but with this difference, that the wood is now kept in the province by legislation,—a policy which could hardly be adopted for pyrites. It is true that we may reasonably hope for a process which will put at our disposal for the sulphite process the unlimited quantities of sulphur in the copper-nickel ores of the Sudbury district; but in the meantime, 'a bird in the hand is worth two in the bush.' The time has come, too, when the manufacture of sulphuric acid, now in its very early infancy in Canada, should be extended to meet the growing demand for this chemical. In both these directions enterprising investors may safely reach out.

The Anglo-Klondyke Mi ing Company.—The directors, in submitting their second annual report, with balance sheet and profit and loss account, for the year ending 30th September, 1902, state :

From the amount of available net profit, viz., £28,467 17s. 2d., the directors recommend the delaration of a dividend of 20 per cent. (free of income tax) on the ordinary shares, payable to all shareholders registered on the 30th November, 1902. This will absorb £24,659 12s., leaving a balance to be carried forward of £3,808 5s. 2d.

The board are very pleased to be in a position to report a much more favorable condition of affairs than last year.

The share capital is now all issued, the shares which were due at the date of the last general meeting to the Consolidated Mines Selection Company, Ltd., and to Mr. Joseph McGillivray, having been allotted.

With reference to the personnel of the board, Mr. J. M. Wilson has resigned, having left England to take up an appointment in South Africa, and Mr. A. F. Nichol has been elected in his place.

Side Lights on the Rossland Boom.

The Rossland *Miner*, a weekly sheet which played no insignificant part in promoting that notorious era of wild-cat speculation in mines and ten-cent shares in Rossland mining companies, has been made party to a law-suit which promises interesting revelations of how the game was played in these memorable days, now happily, and we hope forever, things of the past. The paper was originally owned and edited by John Reevis, who "whooped her up" in lively style, until he was bought out by F. Aug. Heinze, then operating the Trail smelter. A year ago last May Heinze sold the *Miner* to Bernard Macdonald, for the Le Roi Company for $20,000, one-half of the purchase money being paid down at the time, the balance falling due six months later. The utmost secrecy was observed in the sale, so much so that the sale was ostensibly made at Northport to the Northport Smelting Company, which apparently made the initial payment. In reality, however, the charge went through the Le Roi Company's books under the caption of "Special Account," as Mr. J. R. Frecheville discovered when he made his investigation into the affairs of the company the following fall. Frecheville reported that the purchase of the paper was entirely unauthorized, and it was decided to allow the journal to relapse into the hands of Mr. Heinze by making default in the second payment. Mr. Macdonald and Mr. Thompson, although out of the Le Roi, still retained the management of the Le Roi No. 2, and they, with Edmund B. Kirby, of the War Eagle-Centre Star, desired to keep control, so the second payment was arranged for in the following fashion: The Le Roi obtained a cash rebate of $2,500 and retained 750 shares of a par value of $10 per share. The War Eagle-Centre Star people coughed up $7,500 and the Le Roi No. 2 $5,000, receiving in return 750 and 500 shares respectively. Mr. Heinze was paid the balance of his purchase money and very quickly made it publicly known that all his connection with the paper had ceased. The second payment was made just about a year ago, and from that date until about April of the present year the paper was "carried" by the three combinations, viz.: The War Eagle-Centre Star, Le Roi No. 2, and the Le Roi, in proportion to their respective holdings.

Some time in the early spring of the present year Manager Mackenzie, of the Le Roi, who apparently has no great liking for "mining on paper," notified the other companies that the Le Roi would in future discontinue its contribution to the monthly deficit, and arranged to draw out the Le Roi's proportion of the debts owing to the *Miner* previous to that date. The joy of the other partners at this step on Mr. Mackenzie's part can easily be imagined, but as the matter had to be kept quiet at all cost the situation had to be accepted with as good grace as possible under the very trying circumstance narrated.

Some time last month the War Eagle-Centre Star people decided on a move to grab the *Miner* from the Le Roi. The officers of the company owning the paper included A. B. Barker, the local manager of the Bank of Toronto, representing the War Eagle-Centre Star interest, as president; William Thompson of the Le Roi No. 2 as vice-president, and Mr. Wallace, of the Le Roi, as secretary-treasurer, these three constituting the board of directors, and between them representing the entire stock issued, viz., 2,000 shares.

According to the documents on file a suit was instituted last month by John A. McDonagh, of Toronto, against the *Miner* Company, for $3,000 for "money lent"—McDonagh being in reality the War Eagle-Centre Star combination, for whom it is said he has been all along acting as trustee, holding the 750 shares which represent their interest.

The writ was served upon the editor, J. P. Earngey, who now says he "mentioned" the matter to Mr. Barker (the War-Eagle-Centre Star representative on the board and the president of the *Miner* Company) and let the matter rest there. The Le Roi Company say that neither they nor their representative ever heard of the service of the writ until after judgment was signed for the full amount of the claim, in default of any appearance or defence being made by the defendant, the *Miner* Company, on October 31st last.

The Le Roi No. 2 Company also obtained a judgment against the *Miner* for $2,000 for money lent, it is alleged, in the same fashion as that got by the War Eagle-Centre Star combination, and now the wrath of the Le Roi Company has been aroused and a big fight has been commenced against the other companies interested, the first step in which is an application to set aside the judgments referred to.

James Anderson Wallace, the secretary-treasurer of the *Miner* Company and the Le Roi representative on the board, has filed a lengthy affidavit on the pending motion declaring that the judgments n question were obtained without notice to him or his company, and that all the proceedings were kept secret from him and them, and that it was only by accident that the matter was discovered after judgment had been signed.

Mr. Wallace says he offered to sell the 750 shares held by the Le Roi Company to A. B. Barker for his principals at a 50 per cent. discount on the day the suits in question were commenced, and that Barker said he must first consult with the other parties. As has been explained, howeuer, judgments were obtained, and presumably Mr. Barker is still waiting for a reply.

An effort was made to ring in the Rossland Great Western and the Kootenay Mines by selling these corporations 170 valuable Rossland *Miner* shares at par ($2,700) but some one got scared at the probable result and the deal is said to have fallen through.

Whatever may be the outcome of the present state of affairs the story is interestlng as illustrating the situation in mining circles in the Rossland camp.

Mining Institute Awards.

The sub-committee of the Council of the Canadian Mining Institute has recommended that the following awards be made for 1902 in the Students' Competitions:

The President's gold medal to O. N. Scott, School of Mining, Kingston, Ont. for his paper "On the Ore Deposits of Copper Mountain Similkamenn District, B.C. Also two cash prizes of a value of $25.00 each to the following: H. W. De Pencier, McGill University, Montreal for his paper on "Mine Timbering in the Old Ironsides and Knob Hill Mines," and to L. P. Silver, School of Mining, Kingston, Ont. for his paper on "The Sulphide Ore Bodies of the Sudbury District". It is understood that one of the best papers contributed to the series, that by Mr. E. V. Corless, of McGill, last year's gold medallist, was at the special request of Mr. Corless withdrawn from the competition.

The Committee recommend that in the future, in addition to the President's gold medal, the Institute offer three prizes of a cash value of $25.00 each for papers contributed by Canadian Mining Students on the following subjects:—

GROUP I.—*Ore Deposits and Mining Geology.*—The subject may be treated generally, or some particular district or single deposit may be discussed or described.

GROUP II.—*Mining Practice.*—Any and every branch of mining may be treated such as pumping, hoisting, ventilation, timbering, ore extraction, development, etc, etc., or some particular method of mining, or some individual mine or group of mines, may be described or discussed

GROUP III—*Ore Dressing and Metallurgy.*—Any branch of ore dressing or metallurgy may be treated as for example—crushing, jigging, milling, concentrating, smelting, roasting, cyaniding, etc; or some particular plant may be described or discussed.

Protection for Silver Lead.

At a meeting of the Silver-Lead Mine Owners of East and West Kootenay, held at Sandon, British Columbia, on December 10th, 1902, the following resolution was presented by J. L. Parker, and carried unanimously.

1. WHEREAS, The silver-lead industry of British Columbia, notwithstanding the unusual richness of the ore, the proved continuity of the veins, and the favorable natural conditions of mining in the Province, is, and for some time has been, in a declining condition which, if not ameliorated, will end in total stagnation. And

2. WHEREAS, the lead-mining camps of the United States, and particularly those in the adjoining state of Idaho, are and for years have been, enjoying great prosperity, due to a protective tariff conserving the home market. And

3. WHEREAS, the silver-lead mining industry has been for some years of national importance, and, unless allowed to decline, will speedily attain to a much greater degree of importance, benefitting by its increased expenditures the trade and advancement of both Eastern and Western Canada. And

4. WHEREAS, our domestic market for the manufactured products of lead is chiefly supplied from the products of ores mined in Mexico and Europe; where the labor cost of production is much lower than in this country; a condition of affairs permitted by the wholly inadequate protection afforded by the existing tariff; while the prices of white lead, lead pipe, sheet lead and shot, in the Dominion of Canada, are approximately equal to the prices charged for the same commodities in the United States, all to the detriment of the producers, consumers, and transporters of lead in this country. And

5. WHEREAS, under the existing tariff, little or no protection is afforded to the lead producing industries; whilst adequate protection is afforded to all other industries of equal importance, known to us. And

6. WHEREAS, these conditions result in the exportation of a preponderance of our crude ore and bullion, the former to American smelters and the latter to the markets of the world; there to enter into competition with the products of cheap European and Mexican labor, and the surplus product of the protected lead industry of the United States.

7. THEREFORE, we, the silver-lead miners of the East and West Kootenay districts of British Columbia in convention assembled do hereby recommend and respectfully urge the enactment of a Tariff Act which will afford ample protection to the producers, manufacturers and transporters of lead, thereby, creating and fostering a new and expansive home industry calculated to benefit all classes by the stimulation of national trade and commerce.

Having in view the interests of the producers, manufacturers and consumers of lead, we would recommend a duty equal to that imposed by the United States, viz.;

On lead in ores 1½ cents per pound.
On lead in bullion, pigs, bars, and old lead, 2⅛ cents per pound.
On lead in sheets, pipe, shot, etc, 2½ cents per pound.
On white lead, etc., 2⅞ cents per pound.
On all other products of lead as provided in the Dingley Tariff Act of July 24, 1897.

PROVIDED always that if at any time it shall be proved that a combination has been formed for the purpose of unduly increasing the charges made for smelting lead ores produced in Canada, or for refining or marketing lead bullion, or if the charge for smelting and refining in Canada is proved exorbitant, then the Governor-General-in-Conncil may at his discretion permit the admission into Canada of lead bullion smelted and refined, or smelted or refined in foreign countries, from Canadian lead ores, upon payment of an advalorem duty of 15 per cent upon the cost of such smelting and refining.

8. And the Secretary is hereby instructed to forward copies of the foregning resolutions to the Senators and Members of the Dominion Parliament, representing British Columbia, with the request that they present the same to the Federal Government as a memorial with their endorsement.

WHAT IS PIG-IRON?

Mr. David Baker, General Manager of the Dominion Iron and Steel Company, Describes the Metallurgical Practice at Sydney, Cape Breton.

In the celebrated suit of the Dominion Iron and Steel Company, to which reference is made elsewhere, Mr. David Baker, general manager of the company, gave the following evidence :—

Q.—What is your official connection with the claimants in this case? A.—I am general manager of the company.

Q.—And how long have you been acting as such? A.—I came here a year ago. I came the 1st of August last as general superintendent, and last March was appointed general manager, that is March of this year.

Q.—Are you an experienced worker in iron? A.—I graduated at Boston School of Technology in 1885. I began in the steel department of the Pennsylvania Steel Company at Steelton, about three miles from Harrisburg, Pa.

Q.—Is that an extensive works? A —A very large plant, employing 6 000 men, and having a large blast furnace plant, open hearth steel plant, bessemer plant, rail mills and slabbing, and merchant mills.

Q.—And how long were you with the Pennsylvania Steel Company? A.—I was with the Pennsylvania Steel Company, the parent company, until March, 1887, when I went to Baltimore and took charge of the erection of an extention to their plant called at that time the Maryland extension of the Pennsylvania Steel Company. Afterwards it was organised as a separate company called the Maryland Steel Company, I remained with them until 1893, when the plant was, owing to the hard times, shut down completely.

Q.—Then as to the Maryland Steel Company? A.—That consisted of a plant of four blast furnaces, bessemer steel plant, rail mill, machine shop and foundries, and a ship yard for the construction of steel ships.

Q.—Will you continue what your experience has been since that? A.—After leaving them I was one year, from '94 to '95, with the Lackawanna Steel Company in charge of their iron plant at Lebannon and Cornwall, Pa, where they had five blast furnaces. A year later, owing to the starting up of the Maryland Steel Company, I was called back to that plant, and remained with them until December, '98, when I was offered a position with the Illinois Steel Company to take charge of their blast furnace department at the South Works, South Chicago, and left that month for that plant. I remained with them until August 1st, 1901. The Illinois Steel Company's plant consists of nine blast furnaces, ten open hearth furnaces, bessemer steel works, rail mill, plate mill, slabbing mill, and the necessary machine shop and foundry, and a plant for the manufacture of cement.

Q.—Then in all these works you have had to do with blast furnaces have you? A.—In the Maryland Steel Company I started in with the steel plant. I had general charge of their blast furnaces when I left there, and their steel plant. In Chicago I had the blast furnaces.

Q.—Will you tell us what your plant is here? A.—Our plant here consists of four docks, four modern blast furnaces, and our open hearth steel plant.

Mr. CHRYSLER: Explain on this plan where these are situated. A.—Our ore is received at No. 2 pier, the northern end of the works. It is then delivered to our ore bins back of the blast furnaces, and from there taken to the four blast furnaces which are arranged in a line with the regenerative stoves in between the stacks. They are marked "blast furnaces" on the plan.

Q.—Then how far from that is the shop in which the open hearth furnaces are situated? A.—One thousand feet from there the open hearth steel plant begins, that is, the buildings.

Q.—And those are all situated in one building? A.—They are in one building marked "open hearth" on the plan.

Q.—And what do you call the furnaces that are in that building? A.—These are, to speak exactly, "the H. H. Campbell Tilting Open Hearth Furnace."

Q.—How many of them are there? A.—Ten.

Q.—Then what is a blast furnace? Coming back to the first shop, tell us what you do there? A.—A blast furnace is a cylindrical furnace for the manufacture of pig-iron from iron ore. I have here a vertical cross-section of one of the furnaces in operation.

Q.—Will you describe the parts of that? A.—The lower part where the melting process takes place is called the hearth of the furnaces.

Q.—What is the furnace constructed of? A.—The furnace is constructed of fire bricks with a suitable binding material.

Q.—And what is the height? A.—The height of the furnace we have here is 85 feet. It varies considerably depending upon the ore, and the product required, and the size of the furnace. It may be as low as forty feet, or perhaps lower, and as high as 105 feet, and in some cases 110.

Q.—Then what is the diameter? A.—The diameter of these furnaces is 12 feet nine on the hearth, although each one is slightly different. That diameter is changed frequently.

Q.—And what is the widest diameter, and where is the widest diameter to be found? A.—The widest diameter of the furnace is at the top of the bosh, that is the part immediately above the hearth, and the sides of which slope into the hearth. The top of that bosh, where the angle of the furnace changes its direction, is the widest part of the furnace, and in the construction I have before me it is 20 feet. That is about the dimensions we have adopted here for our practice.

Q.—And the thickness of the wall of the furnace above? A.—That varies from 30 inches up to five feet three inches in our construction.

Q.—Take the material that you put in and say what you do with it. What is the material that is used in reducing the ore in the blast furnace? A.—In the practice that we use here, coke is used as the fuel, and limestone or dolomite is used as a flux, and the ore is introduced with these materials, preferably in layers.

Q.—And where is it put in? A.—It is hoisted by means of an inclined hoist to the top of the furnace and dumped in the top.

Q.—Do you carry up the skips of the different materials used, coke, ore, and lime? Is that the order? A—That varies. It is very frequently charged in that way, but occasionally it is charged, coke, limestone and ore.

Q.—And all these materials are put in at the top. Is the top covered? A.—The top is closed by a large casting called a bell, in the shape of a bell, about 10½ feet in diameter. That makes a joint with another casting called a hopper.

Q.—It is really a cone? A.—Yes

Q.—And which way is the apex of the cone? A.—Upwards. The bell is hung by its apex.

Q.—And what is the nature of that? Does it close the top? A.—The use of that is to save gases and force them out of the openings in the side of the furnace.

Q.—The aperture is shewn in the drawing? A.—Yes. An aperature is shewn where the down-take or down-comer is joined to the furnace.

Q.—And the office of the bell is really a valve? A.—A valve and distributer which is used as a closing to the top.

Q.—Then the material being introduced at the top what becomes of it in the furnace? A.—The furnace in operation is kept full within two or three feet of the bell, and as the melting operation goes on in the hearth of the furnace these materials settle and fresh stock is added at the top, coke, limestone and ore.

Q.—And does all material come out at the bottom? There are two kinds of material at the bottom withdrawn? A.—Slag and iron are drawn out at the bottom.

Q.—The iron in what condition? A.—The iron in the form of what is termed "pig-iron."

Q.—And how is it drawn or where? A.—It is drawn in the liquid state by making a hole in the lower part of the hearth of the furnace.

Q.—What do you call that? A.—We call that the iron notch.

Q.—And the slag or cinder? A.—As much as possible is drawn from what is called the cinder notch which is located four or five feet higher than the iron notch.

Q.—Is it shewn on this plan? A.—Yes.

Q.—This is the aperture or the tap? A.—The cinder notch. The iron notch is not shewn there.

Q.—A part of the material goes off at the top? A—The gases and ligher portions of the solid material are carried off through the opening in the side of the furnace at the top and go down the gas-pipe or down-comers.

Q.—You speak of the material being melted in the hearth. Where does the melting operation or fusing begin? A,—Air is introduced through the openings called tuyeres into the hearth.

Q.—Which are blow-pipes? A.—Which are water-cooled casings projecting into the furnace about nine inches.

Q.—And the office is to blow? A.—The air is forced through these water-cooled casings into the furnace.

Q.—Hot or cold air? A.—Hot air.

Q.—Under about what pressure? A.—The pressure here varies from 10 to 15 pounds per square inch.

Q.—Did you state where the tuyeres began? A.—The tuyeres are located on a line about three feet above the cinder notch, and from this point up approximately twelve feet the intense melting action of the furnace takes place. That is called the zone of fusion.

Q.—And above that material retains more or less its solid condition does it? A.—The temperature at the tuyeres grows less as we ascend the the furnace. It grows less upwards towards the top.

His Lordship.—About what is the temperature at the zone of highest combustion or fusion? A.—No very careful measurements have been made. They have only approximated the temperature, and as near as that can be obtained it is 3,500 degrees fahrenheit.

Mr. Chrysler.—It is mentioned in some of the books in centigrades? A.—I could not give it to you in my head. At the top of the furnace the temperature is between 300 and 600 degrees in good working.

Q.—Then it is graded from that down? A.—Down to the tuyeres.

Q.—You have told us the result of the work in the furnace is to produce molten iron. What is that iron composed of? What is the nature of that substance? What is it made of? A.—This pig-iron consists of between 93 and 94 per cent. metallic iron. The balance is non-metallic, and metalloids.

Q.—What are the principal other metals? A.—The principal metals are silicon and phosphorus, and the non-metallic elements are carbon and sulphur.

Q.—Which of these is present in the largest proportion in the usual pig-iron? A.—In ordinary pig-iron carbon is there in the largest quantity.

Q.—And is there any one of these ingredients that is necessary to constitute pig-iron? A.—The metallic iron is all that is necessary, only it must have some other substance with it that will make it possible to melt—make it fluid, so that it can be run out of the furnace.

Q.—And what is that substance? A.—The carbon is the main substance which permits the iron to become fluid, and it is therefore sometimes called a carbide of iron.

Q.—Do you from the blast furnace ever obtain pure iron? A.—Never.

Q.—It is always a compound of of carbon and iron with phosphorus and and usually some other constituents in small quantities? A.—Pure iron is a substance never used in the arts. It only can be obtained as a curiosity in a chemical laboratory.

Q.—In your practice what is done with that molten iron? Is it of use in the production of steel? A.—In our practice we take a portion of the pig-iron direct in vessels called ladles to the steel plant, and a portion goes into our pig-bed, and another portion to a machine called the pig-machine, which is an arrangement constructed to save the expense of casting iron in the sand as was the old-fashioned way, and to make a cleaner iron.

Q.—We will take those separately and get a description. Take the oldest use of those. That was, I suppose, the pig-bed? A.—The oldest means of handling the product of the blast furnace was in the running of it into sand-moulds in a pig-bed, a building adjoining the blast furnace.

Q.—And you do here cast some of the iron in that way in the sand moulds? A—About a third of our iron goes into sand moulds.

Q.—And is the iron from the same source, from the same blast furnace which you cast in these sand-moulds, as the iron that you take to the steel furnace? A.—The iron that is intended for the steel furnace either goes direct in a liquid state, or else goes to the machine.

Q.—Is it the same material? A.—It is the same material.

Q It is the same material? A.—The same material. We occasionally run casts into the sand from the same furnace, and from the same kind of iron.

Q.—Can you take for instance one ladle from the blast furnace to the pig-bed and the next ladle to the steel house? A.—Yes. We used to take it and cast it into sand moulds—carry the liquid and cast it into sand moulds in a building away from the furnace.

Q.—The material that you take up to what I may call the steel house? A.—The steel mill.

Q.—The material that you take up to the steel mill in the ladle, which is a large pot? A.—A large vessel or pot lined with fire brick.

Q.—And which you can raise and pour from. That is the same material that you use for casting cold pigs if you make them? A.—The same thing.

Q.—Then this other arrangement that you speak of which consists of casting the molten metal into a form other than the old one, you were describing that. What is the mould in that case? A.—The pig machine consists of an endless chain of moulds, either made of cast-iron or soft steel,

and the liquid is poured into these moulds, and cooled either by passing through a water tank, or having sufficient length of chain to allow the air to cool it, until it becomes solidified, and then it is dumped into cars.

Q.—Is that metal in the same form as the pigs that are cast in the sand bed? A.—Not in the same form.

Q.—How do they differ? A.—They are a different shape, caused by the necessity of the mould being able to discharge its pig.

Q.—What is it like? A.—It is flatter and shorter.

Q.—It is like the domestic bread pan? It looks so to me? A.—The sides are not as straight as the domestic bread pan?

Q.—It differs quite in shape from the old-fashioned bar of pig-iron, and in weight? A.—It is lighter.

Q.—What would the old pig of iron average, as you make them? A.—From 100 pounds up to occasionally as high as 200 pounds.

Q.—And what do these small ones weigh? A.—These will average about 75 pounds.

Q.—Now the molten pig-iron is conveyed in the ladle to the steel mill; what is done with it there? A.—It is there poured into a vessel we call a reservoir or mixer, which is a reservoir for holding this fluid pig.

Q.—What is the office of that reservoir? A.—Simply so that we can have a supply of metal from which we can draw whenever a charge is required in one of the steel furnaces.

Q.—What is the capacity of the reservoir? A.—Approximately 300 tons.

Q.—What quantity of molten iron would you take from the blast furnace at a drawing? A.—Our ladles have a capacity of twenty tons, and we ordinarily take about 55 tons at a cast. Three ladles we ordinarily take.

Q.—What is done with the liquid iron that is kept in that reservoir? A.—That is kept hot by gas and simply held as a reserve stock.

Q.—What do you do with it? A.—We draw from that whenever they need a charge in the open hearth furnace. When they need another charge we draw from that a portion of what is required for the charge.

Q.—And from the open hearth furnace you withdraw a metal which is what? A.—From the open hearth, steel.

Q.—What form do you cast it? A.—We cast it into ingots.

Q.—And do you sell the ingots? A.—We have no market for ingots here in Canada.

Q.—What is the nature of the steel ingot? Is it a finished product? A.—A steel ingot is not a finished product. It is a raw material for a rolling mill. It is a product that is obtained by pouring metal into a mould of some sort.

Q.—And what is the size of the ingot that you cast? What does it weigh? A.—These ingots weigh 5,500 pounds and measure at the largest end 19 inches square. They are 17 inches square at the small end and about 5 feet 6 inches long.

Q.—Did you say 5,500 pounds? A.—Yes.

Q.—Then do you market the ingots yourself at all? A.—We roll the ingot in the rolling mill. That is another mill. That is shewn further on. This is the open hearth plant, and about 700 feet from there is the blooming mill.

Q.—That is what we call the steel mill? A.—No.

Q.—And in that blooming mill the ingot is further dealt with. What do you do with it? A.—In that mill we heat the ingot. The ingot comes from the open hearth in a partially liquid condition ordinarily, inside the ingot being fluid, and the outside chilled enough so as to retain its shape.

Q.—It is then virtually a flask of steel? A.—Yes.

Q.—With molten steel inside? A.—Yes, and these ingots are taken to the blooming mill and put into what are called soaking pits, a vertical heating furnace, and there heated until they become the same temperature through, and the temperature is high enough to permit the steel to stand the operation of the rolling.

Q.—And what do you do in the rolling process? A.—In the rolling process we pass the ingot through rolls, reducing its size to what are called bloom billets and slabs.

Q.—These are rolled products to be used in other mills. Describe the billet? A.—Anything below a bloom and slab are billets. A bloom is the largest size. Anything above 8 inches or 8 inches square and above is ordinarily called a bloom, and below that it is called a billet until it reaches a size of about ⅜ inch, or you might say a half inch. Then it becomes a rod. These terms lap over. There is no one fixed line that would actually divide the billet or the slab or the bloom, but I have given you the approximate description.

Q.—And the product of the rolling mill is one or other of these forms of steel, and is that finished steel? A.—That is not a finished steel. That is subject to a further rolling process.

HIS LORDSHIP.—Is there any market for it? A.—There are mills here in Canada to handle that, and there are mills in the States.

Q.—And it is sold as steel per ton? A.—It is sold as billets and sold by the ton.

Q.—But the ingots are not sold as such? A.—We have no market for them. Of course possibly there might be such a market but we have not any market. There is no market here in Canada for them.

Q.—Did you finish the description of this sketch? There is another drawing there? A.—That shews what I describe as the tuyeres.

Q.—That is Exhibit 3. A.—This is the blast furnace shewing more in detail the tuyeres and the connection at the tuyeres. This shews also on this plan the relative position of the tuyeres, and the number of them.

Q.—Was there a process of making iron for use in the arts prior to the blast furnace, and if so explain what it was? What is the history of it? A.—The proces of making iron by what is not called a blast furnace is practically a blast furnace however, because it is a furnace in which a blast has been applied to the fire, but resembles more a blacksmith's forge. It was in such a furnace that that the first iron was made. You might say it was properly a blast furnace, because a blast was applied to it. A crude form of bellows was used to form the blast required to make the heat, and that same term has been applied to the largest furnace which is a different process altogether, but is properly a blast furnace, because the air is blown into it.

Q.—And what sort of iron was made in the old furnace? A.—In the old furnace under ordinary conditions a mellow iron was made, an iron that would not run, but would hammer out, and was called wrought iron.

Q.—What was the condition in the modern practice which was absent in the old process? A.—In the old process the temperature was much lower, and the metal did not remain long enough in contact with the carbon to absorb carbon enough to make it fluid.

Q.—And what was its condition? A.—Therefore was practically free from carbon, and contained very little impurity, was very nearly pure iron

Q.—But as to being fluid? A.—It was not possible to make it fluid. It would bail up and become soft enough to be worked under the steam hammer, or through rolls, but would not melt.

Q.—Was there a name given to that method of making iron? A.—Those little furnaces were called forges. One type was called a Catalan forge. The ordinary term is "a forge." The proper name of the furnace was a forge.

HIS LORDSHIP.—What did you say was the diameter of your furnace? A.—At the widest part 20 feet.

MR. CHRYSLER.—All this is described very fully in books. It seemed to me a convenient method of getting at it would be to ask this witness whether this process is described in a standard work, and if he agrees with it we can read the book.

HIS LORDSHIP.—What do you say Mr. Aylesworth? He proposes to refer to some standard work and ask this witness if he agrees with it?

MR. AYLESWORTH.—I have no particular objection. I thought your Lordship's suggestion to my learned friend Mr. Ross was a proper one, that either of us could refer at pleasure to scientific works in the course of argument, not putting them in evidence. I should object to that.

HIS LORDSHIP.—It is practically putting it in evidence to read from the book and ask if he agrees. That is open to anyone on cross-examination, but it is not open on the examination of a witness, I think, under the rules of evidence, if objected to. It may be found very convenient.

MR. AYLESWORTH.—If it is anything compendious by which my learned friend wants to shorten the matter, I have no objection. I do not want it to be done systematically at all.

MR. CHRYSLER.—I only want to point out the convenience of it. There is a lot of material in these books. Without some witness to tell us what the terms mean, we might differ as to the application of them. I thought it convenient while the witness was here to put in such of those citations as we wish to refer to as requiring explanation.

HIS LORDSHIP.—I should be very glad, if Mr. Aylesworth has no objection. Of course I would have to rule as I understand the rule of evidence to be Of course both sides will get their turns according to the well known rule.

MR. AYLESWORTH.—My learned friends will get them from our witnesses in cross-examination, but if there is any term he wishes explained, I have no objection.

HIS LORDSHIP.—I suppose the only objection to your reading a paragraph and asking if he agrees with it, is that it is a leading question. To put it in as evidence in the case, of course, makes it unsworn testimony.

MR. CHRYSLER.—I have a book here. So that your Lordship and Mr. Aylesworth may both understand just what I am doing, let me say this. I have here a book which I understand is the work of the highest authority, Sir Lowthian Bell on the principles of the manufacture of iron and steel. It is the edition of 1884, and I think is the only edition. It is published in London. It is just to shorten Mr. Baker's examination as to the history. There is here a chapter on what is called the "Direct Process for making Malleable Iron," which we can refer to later. We need not trouble Mr. Baker to give evidence about it. There was such a process in use before the metal workers could produce enough heat to reduce iron to a molten condition, as Mr. Baker has just told us, and there was in that way what we find all the books refer to as a direct process of making iron from ore. It is described here. Mr. Baker has given the substance of it already.

Q.—Do you know Sir Lowthian Bell by reputation? A.—Yes. He is considered an authority in the iron business.

Q.—Do you know anything of his position and history in England? A.—Well, he is a proprietor of a very large steel plant in England, and has been president of the Iron and Steel Institute of Great Britain. He has contributed more than anyone else in original research on the blast furnace process, making a careful study of the chemical actions that take place in the blast furnace.

MR. CHRYSLER.—That is the nature of the evidence I want to give from this witness, so that when we come to look at the books we can know whether it has any standing or not. I think that is all I need say about that. I will read this, and my learned friend can object to it if he wishes. It is page 30: "Malleable iron and steel are obtained, as has been described, by the circuitous method of first making pig iron, and then removing the foreign matter which the metal has taken up in the furnace from the materials used in smelting. Any process, therefore, having for its object the production of malleable iron from the ore at one operation, is distinguished by the use of the word 'Direct'." That is the passage with which the chapter begins.

MR. AYLESWORTH.—That is the production of malleable iron.

WITNESS.—Malleable iron or steel, it says there.

MR. AYLESWORTH.—It was read, "Malleable iron."

MR. CHRYSLER.—You are both right. (Reads paragraph again.)

WITNESS.—It is also a "direct" process when you make steel direct from the ore. There are a number of processes for making steel direct from the ore.

Q.—Are they in practical use? A.—They have never been successful.

Q.—Never been successful? A.—Never been commercially a success.

Q.—That is the next step I wanted you to take. Tell us what these were, the principal ones? A.—The process of making pig iron, to make a metal which has a very large quantity of impurity in it, and then take and put it through another process to remove that impurity, has always been thought to be a waste of time and an unnecessary expense, and a great many efforts have been made to avoid this, to make what is called a direct process of making steel. A great many such processes have been devised and patented and tested, but they have all failed as a commercial success. The only place where they are used to any extent is in Sweden where they have an exceedingly rich ore, very free from impurities, to start with. Direct processes have been used there for a great many years successfully.

Q.—That depends for its success upon the quality of the ore? A.—Upon an exceedingly rich ore which they have.

Q.—What do you mean when you use the words "Direct process" in the sense in which you have been speaking of it? A.—A process to go direct from the pig iron to the steel, and not to make an intermediate product. I mean a process to go from ore to the steel, and not to make an intermediate product called the pig iron, necessitating the very expensive process and plant of the blast furnaces.

Q.—That is a direct process as you have used the words, and I suppose that the words are very frequentiy used in the text books? A.—I might add right here in explanation, that the reason this has been sought for is that at one time in the blast furnace the metal is practically in its pure state, and if we could arrest it at that time we could make it into steel at a very low figure. It has been the aim of metallurgists for a great many years to design some furnace where they could arrest the process, and not make this intermediate product of pig iron.

Q.—What is the nature of pig iron in connection with your present evidence? How does pig iron differ from pure iron or steel? A.—Pig iron differs from pure iron or steel in that it has so much impurity it is fluid at a very much lower temperature. It has about 7 per cent.—between 6 and 7 per cent. of impurities, carbon and other metals.

Q.—How much of it is carbon? A.—Between 4½ and 5 per cent.

Q.—And that gives it what? A.—That mainly gives it fluidity.

Q.—Does silicon aid it? A.—Yes very much, but we can get iron that is very low in silicon and still have it fluid.

Q.—When you have this in its molten state do you do anything to expel the carbon? A.—There we burn out the carbon and silicon and remove the phosphorus.

Q.—You do burn out the carbon and silicon? A.—After it arrives in the steel plant we do that. That is in the open hearth furnace.

Q.—But the heating or keeping it hot in the reservoir, that is simply keeping it hot? A.—I have not explained the steel process. That is carried on in the steel process.

HIS LORDSHIP: You need the impurities relative to iron to get it in the fluid state, and then you need to expel them in order to get the steel? A.—Yes. It may be well for me to explain the steel process. The steel process which is most widely used is the one invented by Sir Henry Bessemer, and there we take the product of the blast furnace, this pig iron, and force through it air, and burn out these impurities. That is done very rapidly, and enough heat is generated by the combustion of these impurities, the carbon and silicon in the pig to keep the temperature up so that we can in the one process get a metal which is exactly the same composition as wrought iron. Of course it is not wrought, it is in a fluid state. The temperature is so high it has the same composition.

MR. CHRYSLER: Then what is the composition? A.—The composition of that is practically pure iron. Very low silicon and very low carbon. These elements are not absent altogether, but in a very small percentage.

Q.—And if you withdraw it in that state and allow it to solidify, what would the metal be? A.—It would be what they call ingot iron. It would not be wrought iron, but practically the same composition.

Q.—Consisting of very pure iron? A.—Yes.

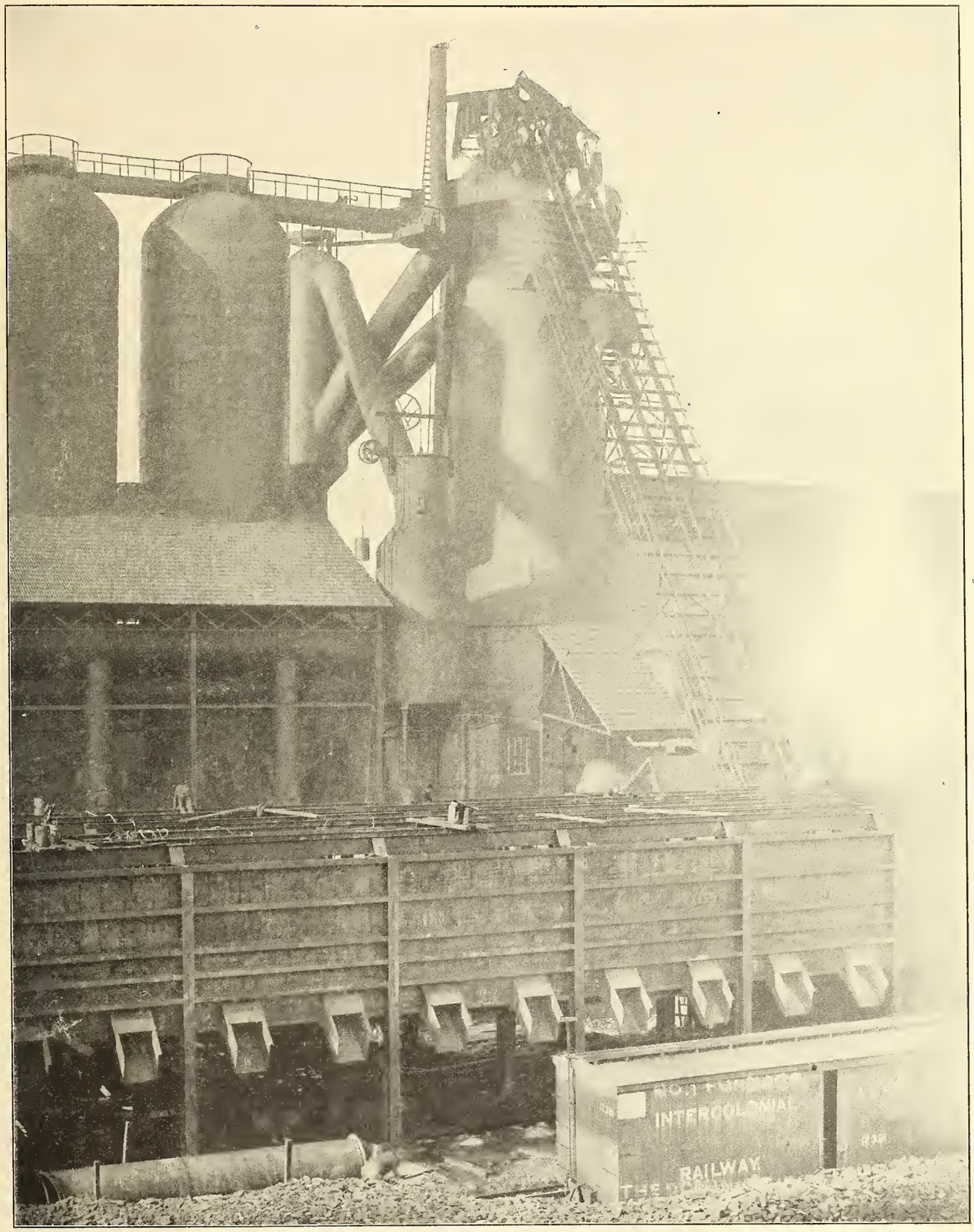
Q.—Then what is it you desire to do with it to make steel? A.—To make it into steel in this form, this ingot iron would be practically useless, because it is so full of gas when it solidifies the steel is full of blow-holes. or rather the metal is full of blow-holes. By adding a little carbon and a little manganese, we will make out of that metal a solid mass that will work better under the hammer and rolls, and be more useful in the art than the material termed ingot iron which is practically the same composition as wrought iron. We make a better material even than the wrought iron which is worked by hand.

Q.—And the object of a steel mill in brief is what? I refer to the plant that you have? A.—The object of a steel mill is to remove the impurities from pig iron, and to put back enough into the same metal—a considerable quantity into the same metal, so that we will have a product, so that we know what it will be, and know what it will do.

HIS LORDSHIP. Is the carbon that you expel the same as the carbon that you put in? A.—It is in a different state. Carbon exists in pig iron. There is a great difference in opinion. Metallurgists claim it exists in four different forms. We recognize two different forms, the combined form and the uncombined or graphitic, and that is termed by the furnace men kish. That flies off the metal while hot and blows off in the air. If we get it on our hands it has the same feeling as graphite, and analyzes nearly pure carbon, which graphite is.

Q.—When you add carbon again? A.—It is in a combined state.

Q.—The combination is different from the combination in pig iron? A.—Yes. I did not describe the open hearth process. The process we use here is the open hearth process. We could not uee the Bessemer process here. We could not use the Acid-Bessemer process. The Bessemer processes are of two kinds. One kind that is most in use does not remove the phosphorus. That is the cheaper one. The one that removes the phosphorus is an expensive process and only used to a limited extent. In order to make the Bessemer process a success enough phosphorus has to be present in the pig iron to form a temperature in the process to keep the metal hot, and therefore this ore that we have to work here does not have enough phosphorus in it to make the temperature high enough to conduct that steel process. Another process was chosen which is called the Basic Open Hearth process. In that process we line the furnace with a material which has the power of removing phosphorus. It forms a slag over the metal, and that combines with the phosphorus and is removed. We add a material also to form this slag. We



DOMINION IRON AND STEEL COMPANY, SYDNEY, CAPE BRETON.

View of Furnaces, Skip Hoist and Bins.

add lime, which has the same effect as a lining, and the lining with a basic material is considered the best among chemists. The lining we put in an Open Hearth furnace is a basic lining. Usually we find the oxides of magnesia or magnesium, or magnesite as it is termed, to be the best lining we can use in the Basiac Furnace, Therefore we import that material to us to line these furnaces.

The charge that is put in the open hearth furnace consists of a quantity of scrap. There not being any scrap market here where we can obtain scrap, we use only what we make ourselves, that is the ends that are cut off in the blooming mill, and which ordinarily is about 12 per cent. We use with that cold pig. As the steel mill runs six days in the week, and the blast furnaces continuously, we therefore have one day's product which has to go to the open hearth and be re-melted, and cannot be taken direct as liquid pig, and and therefore that forms a portion of the charge in the open hearth. We put a portion of the cold pig in, and the balance we take in a liquid state from the furnace. The first operation is to cover the open hearth furnace with ore and with lime, burned lime. The effect of the ore in the lime is to make a slag. The ore gives up part of its oxygen to the metal, coming together. This oxygen combines with carbon and forms gas $C O_2$, carbonic acid gas, and the balance of the ore goes into the slag with the lime, forming a very thick slag, which combines with the phosphorus, and it is by that means we take the phosphorus from the metal. After the phosphorus is removed the carbon is removed next, and I might add that the silicon goes off first, and then the phosphorus and carbon.

Q.—Did you explain how the heat was applied to the furnace? A.—Here is a plan. This is a section of the open hearth furnace. (Exhibit 4.) This shows a section of the open hearth furnace.

Q.—The furnace has a top, it is a covered furnace? A.—Yes and the gases and hot air are put in one end, and the product taken out of the other. It is properly called a reverberatory furnace. They reverberate against the roof and go out this side. This represents the cross-section of the furnace through the shortest diamater, and shows the spout out of which the metal is forced; and, that is the hole through which the gases ultimately pass in going out. They are called ports. This represents the flues which enter into the chambers where the brick work is piled up crossways so as to form a checker work, and the products of combustion virtually pass through one chamber and another, and heat this chamber, and here we have valves, so that we can reverse this operation. We can pass our gas in for making the heat in the furnace through this side, and the product comes out this side, or we can reverse the arrangement and pass gas through here and the product out that side. The rule is every 30 minutes to reverse and make the products pass through chambers that we have been passing the air and gas through previously, and therefore every time a change is made the temperature of the furnace goes up and any temperature can be reached in there.

Q.—How does the heat in that furnace compare with the blast furnace? A.—This can be just as hot. This furnace is invented by Siemens. It made it possible to make steel in an open bath like that—in an open hearth furnace.

Q.—It is sometimes called a bath? A.—Such a temperature was not obtainable until the invention of Sir William Siemens of these regenerating chambers, and by that a part of the waste is returned to the process each time.

Q.—Who is the originator of the open furnace that you have in use here? A.—This is a modification of the Siemen's furnace invented by H. H. Campbell the General Manager of the Pennsylvania Steel Company, and the inventor of the Tilting Open Hearth Furnace.

Q.—Then about the Tilting. Shew how that is done, and any feature peculiar to this furnace? A.—This furnace stands on a steel rocker, and these are the steel rollers which rest on this base casting, and the hydraulic cylinder is here. There are two ram cylinders. By turning on one we turn this this way. It will tip right over and tip to an angle of 45 degrees before running out of that spout. When that metal comes out there it is practically wrought iron. It is very low in carbon, but it is extremely fluid, because the temperature is so high, and in the ladle we put the Manganese which contains the fixed quantity of carbon and occasionally coke, if we have to make a steel of higher carbon than manganese will give us by its addition. We here shew the ladle we bring the pig iron in from the furnace, and here are the steel cranes left out of the drawing.

Q.—Then Mr. Campbell of the Pennsylvania Steel Company was the gentleman who invented the type of furnace you have in use. "The manufacture and properties of structural steel, by H. H. Campbell." That is the same Campbell? A.—Yes.

Q.—So that we have a book here by the man who designed that furnace? A.—Yes.

Q.—How long since the furnace was produced? A.—The first experiments were made in that furnace in about '95 as I remember it. I was in Maryland at the time in the employ of the Pennsylvania Steel Company.

Q.—Do you know Mr. Campbell personally? A.—Yes, and have known him for a good many years. He has written the best work on structural steel. He is considered the highest authority in the manufacture of steel by the process we are using here, that is in this country or on this continent.

Q.—This is the work you are referring to? A.—That is the one in print. There is a later work I have not received a copy of.

Q.—This is "The Manufacture and Properties of Structural Steel by Harry Huse Campbell, S.B., Bachelor of Science," published in New York in 1896. In the Preface states that a considerable part of this work was published originally in the transactions of The American Institute of Mining Engineers, and other chapters recently appearing in the transactions of The American Society of Civil Engineers. Do you know what these Societies are? A.—They are Engineering Societies of The States.

Q.—And what is the nature of the transactions? A.—The volume is published yearly containing the papers read before their several meetings representing work and researches done by the members of the Society. It is considered a document that is more nearly up to date than any publication we have in science.

Q.—The transactions are considered authoritative? A.—They are published by leading engineers as the result of their observations up to date.

MR. CHRYSLER: There is a passage in the same work of Bell I would like to read. I think it is an example of part of the evidence you have given. It has reference to the question of the combination of carbon with the iron in the furnace. Page 155 of the same book :—

"Carbon is well known to possess a certain affinity for iron; but perhaps it would be more correct to designate their union in cast iron as chiefly due to the property on the part of the metal to dissolve the metalloid." What is meant by metalloid? A.—Metalloid is the carbon.

Q.—You called carbon an non-metallic substance? A.—It is between the two, and it is therefore called a metalloid by some chemists. It has not the properties of a metal, and therefore it is given that name. "The proportion of carbon in this form of solution never approaches the point where the two are present in the ratio of their combining equivalents (28 Fe to 6 C, or 4.66 to 1) The actual relation between the two is nearer 6 equivalents of iron to 1 equivalent of carbon."

"When the metal leaves a furnace which is producing rich iron, as it loses heat, it gives off a portion of its carbon, in the form of thin, black and brilliant flakes, known as "kish." The same thing happens again when the metal solidifies on cooling, the extruded carbon being deposited on the faces of the crystals in pig iron, in what is known as the graphitic form."

"A certain portion of the carbon in pig iron is regarded as existing in combination with the metal; and at one time it was considered that the whole of the carbon in white iron was of this character. It was also held that there was a necessary connection between the "richness" or large sized crystals of the iron and the quantity of carbon it contains in the graphitic form. The extruded kish, is however rarely a pure substance, iron in greater or less quantity being generally present with the carbon. After tapping one of the Clarence furnaces, a considerable quantity of flakey matter was collected from the surface of the pigs. By means of a magnet it was separated into two portions."

That is page 155 of Bell. That contains what Sir Lowthian Bell has to say with reference to the question of the combination of carbon with the iron, being a solution or chemical combination, and I think you said that that was really a disputed point? A.—It is, yes.

HIS LORDSHIP.—That is whether the combination is chemical or mechanical. Is that the dispute? Whether the union is chemical or mechanical.

MR. CHRYSLER.—The mechanical combination is one thing. A solution is something intermediate between the chemical and mechanical.

WITNESS.—The solution is different.

HIS LORDSHIP.—In the chemical combination they unite and form a different substance.

A.—The substance is different, but in solution the substance is taken up and goes into it, and disappears as a substance. But in the mechanical you can see the substance just mixed up, and that is where a part of the carbon is mixed up with the air and floats off, and when you break it cold you can see it there.

MR. CHRYSLER.—Do all these three occur in the combination of iron and carbon in the blast furnace? A.—The best information we have today is that carbon exists in all three forms, if not in a fourth form in the pig iron.

Q.—The mechanically mixed, in solution, and also in part chemically combined? A.—Yes.

Q.—That is correct, is it. Then how long has your furnace been in operation—the blast furnace? A.—These blast furnaces were started in February 1901.

Q.—And when did you begin to manufacture steel in the open hearth furnace? A.—We made the first steel in December 1901.

Q.—And in your practice here you have been using the liquid pig iron only since December 1901 then? A.—For making steel.

HIS LORDSHIP.—About six-sevenths of it from what he said is used in the liquid state.

MR. CHRYSLER.—What proportion since? A.—If the open hearth were ready to take all the iron we aim to get six-sevenths of it, but the result is we usually take about three-quarters of what we use. We cannot hit it every time. Sometimes we have five or six open hearth furnaces that need to be filled at the same time, and we have not metal for them, and have to take the cold.

HIS LORDSHIP:—Do you take that off the rollers in the form of pig, or in what form do you take the other article that you allow to cool and melt again? A.—If we expect to use it in the open hearth we put it through the machine so as to have it free from sand—through our pig machine. If the sand adheres it attacks the lining of the open hearth and would cut it away.

MR. CHRYSLER:—For instance your Sunday product? A.—What is intended to be used at the steel mill goes to the machine.

Q.—Then you do reduce the seventh to pig before you use it? A.—Yes. It is called pigs. They are not the same shape as we make in the sand, but they are termed "pig iron." The product we sell in the market is mostly the sand pig, because the casting of the iron in the machine changes the grain of it, and our customers for the most part prefer the sand. However, we have a great demand for machine iron now because it is cleaner. That is something that has been caused since the introduction of the mechanical arrangement for making pig.

HIS LORDSHIP:—A little more than your Sunday product you use in that way. So that about a quarter of it all goes to the pig machine before it goes to the steel? A.—Yes.

Q.—Before it goes to the open hearth furnace? A.—Yes.

MR. CHRYSLER.—And is sold sometimes. A part of what you sell as pig iron is part of that? A.—Part of that iron we run through the machine is sold. Part is sold and part goes to the steel mill, but we aim to have all the iron that goes to the steel mill, that is not taken in a liquid state, put into the machine so that we can get it cleaner and be free from sand.

Q.—Then as the result of what you have described, from the blast furnace you get a compound substance largely composed of iron, with some proportion of carbon, which is for steel-making purposes an impurity? A.—Yes.

Q.—Has it any advantage for any other purpose—the existing impurities in the iron? A.—It renders the iron easily fusible.

Q.—And therefore suitable? A.—For making castings.

Q.—It is that very property, of a low point of fusion, which makes it valuable as cast-iron? A.—Yes, that is cast-iron.

Q.—What is the difference if any between the meaning of the words "pig iron" and the words "cast-iron"? A.—The word "pig iron" is a term common to the product cast at the blast furnace, and "cast-iron" is the same metal cast at a foundry, but we make castings out of blast furnaces also.

Q.—But pig iron for the purposes for which steel is required, is impure iron? A.—It is impure iron.

Q.—Which requires a further process of refining, and that is accomplished in your steel mill? A.—Yes.

Q.—In the open hearth furnace which you have described? A.—Yes.

Q.—Now with reference to the Bessemer process, you have described that as blowing air through the metal? A.—Yes.

Q.—I find that described in a passage I would like to read from the Encyclopædia Britannica, an article on iron, Vol 13 of the '91 edition, which is the last edition. It is an example of the history of the process that Mr. Baker has been giving us in the language of the author of this, article, page 290:

"General classification of methods employed for the extraction of Iron from its ores. The various modern developments of the earliest methods of iron extraction consisting of the heating of iron ores with fuel until more or less complete reduction was brought about, and hammering the mass, may be conveniently divided into four classes, viz:—(1) those in which cast iron is produced by a smelting process (secs. 9-21), and subsequently transformed into steel or wrought iron by decarbonizing the resulting pig iron (secs. 22-28); (2) those in which malleable iron or steel is obtained direct from the ore at one operation without passing through the stage of cast iron (secs. 29-31); (3) those in which steel is formed from wrought iron by directly carbonizing it (secs. 32-35); and (4) those in which steel is finally prepared by intermixture of carbonized and wrought iron in the fluid state (secs. 36-41). The methods of class 1 include the preparation of pig iron; its purification by refining, and conversion into wrought iron by fining and puddling (both by hand and machinery) and by inverse cementation (heating in contact with iron oxide); and the preparation of puddled steel and pneumatic steel and iron, i.e. steel prepared by Bessemer's original process, viz., decarbonization more or less complete by blowing air through molten pig iron, and also of Heaton's steel (pig iron decarbonized by nitrate of sodium), &c. Class 2 includes the Catalan forge and allied processess, and the "direct" methods of Clay, Chenot, Yates, Blair, Snelus, Du Puy, Siemens, and others. The processes included in class 3 are those of steel manufacture by cementation and partial acieration by case hardening, together with various other allied methods of producing steel from soft iron; whilst class 4 includes the Bessemer-Mushet steel process, in which blown Bessemer metal is made into what is usually known as 'Bessemer steel" by incorporating with its spiegeleisen; and the allied open hearth steel processes, in which wrought and cast iron are melted up together, or iron is decarbonized in a Siemans hearth and then mixed with ferromanganese, &c., together with various modifications of these processes, such as the Snelus-Thomas-Gilchrist method of blowing phosphorized pig, the Uchatius process, the Ponsard process, &c."

Q.—That is the very beginning of the article. It is introductory to a great deal of a much more technical description which follows. The reference there to the Bessemer process is what you have described? A.—Yes, the Bessemer process, or the Pneumatic process.

Q.—The essential feature of which was? A.—The forcing of air through the liquid pig, which caused the combustion of the impurities.

Q. That is still in use. You mentioned the Illinois Steel Works? A.—Oh, all the rail steel that is made in the United States is made by the Bessemer process. All the steel rails made in the United States are made by the process of Sir Henry Bessemer.

HIS LORDSHIP.—Are you making any steel rails? A.—We are not. We are building a rail mill, but it is not completed.

MR. CHRYSLER.—In the practice of the Bessemer process, is the metal taken as liquid pig iron to the converters in any of the establishments that you know of? A.—In all the plants of any size in the States, in fact all the rail mills in the States take the metal fluid pig to the Bessemer plant.

Q.—And does the quantity of fluid pig iron produced and used in the manufacture of steel bear any considerable proportion to the whole quantity of iron manufactured in the United States? A.—Most of the iron manufactured in the States goes to the manufacture of rails.

Q.—And used in the manufacture of steel? A.—Yes.

Q.—I am not sure we got the answer with regard to the use of liquid pig iron as I asked the question. Is it taken from the blast furnaces to the Bessemer converters in this plant direct in the same way that you do it here. A.—Just the same as we do it here.

Q.—Carried in a ladle? A.—Yes.

Q.—And can you say what proportion was used in the steel manufacture that never became cold? A.—I could not tell you exactly, but all of Carnegie's plant. The United States Steel Company used that process altogether in their open hearth Steel furnaces and in their Bessemer Steel furnaces, so I think you could safely say that 90% of the steel that they make is made in that way.

MR CHRYSLER.—Q.—Then you say to your knowledge a large proportion of the pig iron manufactured in the United States is used in its liquid state in the manufacture of steel? A.—Yes.

HIS LORDSHIP.—That is, of that proportion of the pig iron that is used for the manufacture of steel, the larger proportion is used in the liquid state? A.—Yes.

HIS LORDSHIP.—And he also does say, I think, that the larger portion of the pig iron is used in the manufacture of steel.

WITNESS.—It is all given on the sheets, but I should say the most of the pig iron made in the States goes into the manufacture of steel.

HIS LORDSHIP.—And principally in a liquid form? A.—And principally in a liquid form. Of course one day in the week is cut out. Usually in a large plant they get 75% to 80% of their metal from furnaces as fluid pig, and the balance of cold pig.

MR. CHRYSLER.—That is the present state of the art in the United States. Tell us what the advantage of that process is? What is the advantage in carrying the molten liquid metal direct from the blast furnace to the steel works? A.—It seems a waste of heat to allow the pig iron in the furnace to get cold and then take it to the steel mill and heat it up. Therefore, it has been the effort of metallurgists and steel works managers to stop that cooling off, and to save that heat, and to take the metal that is with its original heat into the steel mill.

Q.—Were their recognized diffculties in doing that? A.—For a long time the direct process was considered no advantage at all, that is taking liquid pig to the steel works, because you did not get such an even mixture of iron. taking a fixed quantity at one time in the furnace, whereas if you took your metal from a pile of cold pig you would get a more uniform average of what the furnaces made, and it was not until Captain Jones of the Carnegie Company invented the reservoir or mixer, a vessel where the metal could be poured in and held and allowed to mix, that the process of taking pig iron direct to the steel works was proved a success. Since then it has been widely adopted.

Q.—When was it that that was successfully done in Carnegie's works? How long back does that date. A.—I think in about the year 1885 as I remember. About that time, I remember the time when it was introduced, and I saw the first mixer built.

Q,—And what is the point about the mixer? What is cured by mixing it? A.—An average product of pig iron that will give more uniform results.

Q.—And why was it that using a small charge direct from the blast furnace, taking it to the open hearth or the Bessemer converter, was considered unsatisfactory? What is avoided now? A.—In the adoption of the reservoir a more regular product of pig, a more regular analysis of pig is produced. For instance when they took the metal in a liquid state direct from the blast furnaces without putting it in this reservoir, just at that time the mill might not be working as well, and the whole operation of the steel mill would be impeded or probably disastrously affected as so as to injure the product.

Q—You are not answering just the question I had in my mind. Does the product of the blast furnace at the tapping vary from one drawing to another? A.—It varies, and varies in the same drawing in analysis.

Q.—How would it vary in the same drawing? A.—A furnace ordinarily is tapped every four hours, and during that four hours the operation of smelting might be interfered with. The regulating materials must settle down gradually and steadily. If the furnace for instance is allowed to become too hot, the material in the lower part will adhere to the walls, and a scaffold will be formed which will hold up this enormous column of ore and coke and limestone, and until a space below is formed, and the scaffold, unable to support any longer, gives way, this material drops in unprepared, it is very much cooler, being held higher up, and it drops the temperature of the bath below—very much lower than it should be, and the elements which are kept out of the iron, sulphur for instance, which in order to eliminate it is necessary to have a higher temperature, and the Basic slag, is allowed to enter the iron, because the temperature is lowered by the sudden introduction of cold material, and that may all happen in the four hours, and sometimes, in a furnace not working steadily, the first part of the cast may be one analysis, the first part of the metal run may be one analysis, and the last part be a poorer analysis, that is inferior for the use of the steel mill, a greater per cent of impurities, and especially those we wish to eliminate. For instance sulphur. The blast furnace process has the power of removing sulphur almost altogether, and in order to remove it the process must be carried on regularly and evenly.

HIS LORDSHIP.—Then this reservoir where you put it mixes the one drawing with the other drawing, and it becomes uniform? A.—In the first drawing we aim to get the sulphur lower than we need it, and if we have a little metal that is higher in sulphur, that will simply raise the average not above the point where it is worthless, but to a point perhaps on a line, or as near the limit as we should have it in the metal to make it a successful product.

MR. CHRYSLER.—And in the reservoir you are adding at one point from the liquid metal from the blast furnace, and withdrawing regularly and successively charges for the different open hearths? A —Yes.

Q —A large quantity remaining constantly in the reservoir under heat? A —I might add :—One of the disadvantages in handling pig iron direct to the steel mill is that this iron cools off, in the vessels we use, the ladles and a large percentage of scrap is made there, and it is only since they have made these ladles very large that we are able to carry that without so much loss of scrap that it would make the process too expensive. That was the first objection when the process was started that there was a large percentage of scrap made that had to be re-melted.

Q.—To go back to the introduction of this process at the Carnegie works. Was the process known of conveying the pig iron from the blast furnace to one or other of the forms of convertors before Captain Jones' invention? A.—Yes, long before that.

Q.—But there were disadvantages connected with it which prevented its being adopted? A.—Prevented its being adopted widely.

Q.—But it was known and was in use? A.—Yes, before 1860 sometime. I think in '50 sometime if I remember, it was first used.

Q.—Now you have been speaking hitherto of the United States. How is it with the art in England? A—They use what is called the direct process there, taking pig iron liquid direct from the blast furnace.

Q.—And how long ago was that in use in England? A.—I could not say. I think it was introduced there long before it was in the United States. I might say I spoke of the direct process. There are a great many direct processes of making steel, but taking the liquid pig direct from the furnace has the short name of "direct process." We have adopted that, but it is not a direct process of making steel. That has to be distinguished from the direct process of making steel which would mean the operation of making steel direct from the ore, which is carried on to-day. A great many different furnaces have been devised to handle it.

Q —Although the term "direct process" is applied to what is done here, it is described in the books as the process of the manufacture of steel from iron ore? A.—You will see in all the references in the long extended suit with the Carnegie Company on their patent mixer they use the word "direct process." That means carrying the pig metal right through to the steel works.

Q.—You have said that this metal is pig iron. What do you say as to the use of the name? What do you know of the use of that term? A.—Well the term pig iron is a very old term, and given to the product of the blast furnace, because it assumes, as the furnace men termed it, the shape of pigs and sows. It was to their advantage to make runners in the sand, and from these runners to make shorter ones, about three feet long, and these short runners, when they were filled, form the pig, while the long connecting runner they called the sow, from its crude resemblance to a sow nursing a lot of pigs it got its name. The product of the blast furnace got the name of pig iron. But, that is a term used in a great many cases for the same metal, whether it is cast in the molten or not. It is a name given to the product of the blast furnace. Some of the blast furnaces cast their pig iron in long runners, and some in plates, but it all is termed pig iron.

MR. CHRYSLER.—I do not think my purpose would be accomplished then.

MR. ALESWORTH.—Then I do not think the purpose is legitimate. If he wants to have the witness affirm what is simply argument, that is uot a legitimate purpose.

HIS LORDSHIP.—The difficulty I understand is this. The text itself in not evidence to commence with. The text could only be made evidence by being sworn to by the witness. He would not be allowed to use the text to refresh his memory. If he himself remembered and could state the same thing, why he might state it. To read him a paragraph and ask him if that is his view, has the objection of being a leading question, and although it might not be objectionable with this witness, it might be with another witness. However, you have a perfect right to ask him the explanation of any term of which he kuows the meaning, and which we do not know, to assist us when we come to read these works, if you do read them in argument, and enable us to understand them the better, or to explain any process, or anything of that kind. To that extent of course you have a right to look at them. If you find a given process you can ask him what he knows about that process, and to explain it. If you find a given term you can ask him what the term means or has reference to.

MR. CHRYSLER.—That is what I wish to do. I will not ask him any questions of the other character.

MR. CHRYSLER.—I refer to this as authority at page 292 of the same article, column 1, line 43 (Encyclopedia Britannic)

"To carry out this operation the blast furnace is employed, the ore, flux and fuel being charged in at the top of the erection, and air being blown in at the base, so that a mixture of carbon oxide and nitrogen is formed at the lower levels, which, passing upwards, effects the deoxidation of the ore; the heat produced at the base fuses the reduced iron and the earthy matters &c., Which accumulate in two layers (the former being the heavier), and are drawn off from time to time, the one as cast or pig iron, into moulds for the market, the other as cinder or slag, usually of little or no value. Fresh materials are added at the top, so that the furnace works continuously."

Then at page 295.

MR. ALESWOTH —I think my learned friend is doing the very thing he was not to do. I do not know that is objectionable at all, except that it is taking time uselessly.

HIS LORDSHIP.—If objected to I could not allow Mr. Butcher to extend that on his notes. When you come to argument you can read it. You are simply putting in the text.

MR. CHRYSLER.—There are some passages of this as to which I wish to ask the witness the meaning of the technical terms.

HIS LORDSHIP.—If Mr. Alesworth objects I do not think Mr. Butcher would be allowed to put that on the notes.

MR. CHRYSLER.—Then how am I to use this book when the witness is gone?

HIS LORDSHIP.—You can use it as a matter of argument.

MR. CHRYSLER.—I desire to ask about the meaning of the passage in the next page, page 295, column 2, at the bottom, "Flux and cinders—When a very pure iron is smelted, such as Cumberland haematite or Swedish magnetite, the amount of silicious and earthly matter present relatively to the iron oxide is but small, and in consequence the amount of flux requisite to be added is also small. By proper combination of ores of different kinds the necessity for the addition of flux may be almost or altogether avoided; thus a high aluminous ferric oxide known as bauxite (valuable as a source of aluminium and its compounds, as well as servicable as a source of iron and flux in the blast furnace) and silicious haematite smelted together, with the addition of a little limestone or quicklime, furnish a cinder consisting mainly of calcareous aluminium silicate which readily melts and separates from the pig iron."

Q.—What is bauxite? A.—Bauxite is a mineral that is rich in alumina and the alumina is an element that is hard to handle in the blast furnace. It requires a special slag to carry it off, to make a fusible material with, or a fusible substance with.

Q.—What he is dealing with there is a mixture of ores apparently? A.—Yes. Some ores are difficult to smelt, and some are smelted easily. Those difficult to smelt require a special flux added to carry off the impurities, otherwise they form an infusible mass in the furnace, and the fusing operation is stopped.

Q.—Is the bauxite a flux then? A.—It is not ordinarily called a flux. The term "flux" depends upon what kind of a smelting operation is being carried on. What is a flux in one operation would not be in another operation. A flux is a material added which combines with the impurities and forms a fusible mass, a mass that will fuse at the temperature you maintain in your smelting operation.

MR. CHRYSLER.—I do not wish to persist in this if my learned friend objects.

HIS LORDSHIP.—I am afraid I will have to rule with Mr. Alesworth if he does object.

MR. CHRYSLER.—It only involves that inconvenience. We have these passages and shall rely upon them at the argument. It seems to me it is a convenient way to enable Mr. Aylesworth to cross-examine the witness if he desires to do so.

MR. AYLESWORTH.—I do not think it is convenient to argue the case now.

HIS LORDSHIP.—Of course Mr. Aylesworth on cross-examination will be able to refer to texts and to authors which you cannot do at present. You can on re-examination refer to the same thing if he opens it on cross-examination.

MR. CHRYSLER.—Then I will reserve the remainder of that. That article is a most instructive article from beginning to end, and there are a large number of passages I will read later on the argument. I will ask now as to some of the books we have here.

(Adjournment 1 until 2 p.m.)

MR. CHRYSLER resuming.

Q.—We have a set of photographs which I was not aware of. We will put them in for the information of the Court. What is that photograph? A.—This print shows the entire plant, that is except the coke oven. (Exhibit 5.)

Q.—Shewing in photograph the structures that are shewn in Exhibit No. 1? A.—Yes.

Q.—You have written upon the face what it represents—the three principal structures shewn there? A.—Yes.

Q.—These are the blast furnaces, the open hearth and the blooming mill? A.—Yes.

Q.—Now, what is Exhibit No. 6? A.—Exhibit 6 shews the plan of furnace, shewing four blast furnaces, the boiler house and engine house and stock house. Also the cast houses.

Q.—Do the run-ways for the skips appear in this? A.—It shews half of the skip-way on which the skip travels which fills the furnace.

Q.—And Exhibit 7? A.—Shews in detail on a larger scale the side of the casting house and the spout projecting through which the liquid pig is run into the ladles.

Q.—Which are there shewn standing? A.—Four of them shewn standing upon small trucks.

Q.—Then Exhibit No. 8? A.—Exhibit 8 shews the front of the open hearth furnaces, and the methods of charging the cold pig into these furnaces.

Q.—It shews one of the charging boxes with the metal in it? A.—Yes.

Q.—It is a piston or ram? A.—Yes.

Q.—Then Exhibit 9? A.—Shews the interior of the open hearth building, the opposite side from the other Exhibit, and shews the crane holding a ladle of steel and steel being tapped into the ingot moulds on trucks.

Q—A question has been raised, I don't know how it came up, whether in discussion or examination, whether the molten pig as you have figured it there and described it in these ladles is a merchantable article capable of being sold? A.—Yes, we would sell it if we had a plant located here and wanted to buy it. It is capable of being sold all right. It is possible to sell it, I mean.

Q.—To a concern under a different establishment? A.—If there was a foundry establishment here, and they wanted to get pig iron from us direct, and we had a portion of our product that was not needed in the steel plant, we would be glad to sell to them, the same as we are selling the pig we do not need in our steel plant now in general markets.

Q.—How far in practice has this molten metal been carried in ladles of that nature? A.—About six miles is the longest distance I know of it being handled in large quantities regularly. That is at Cleveland.

Q.—And it is actually being carried that distance there? A.—It is carried by an independent railway in Cleveland.

Q.—By railway not belonging to the works? A.—Shipped as freight under all the regulations of freight traffic.

Q.—And is it shipped to a different concern? A.—No, this concern has a plant of furnaces located a long distance away from these mills.

Q.—But not owning the railway which connects them? A.—No; they have to pay freight on this commodity. That is the Newburg Steel works of Cleveland.

Q.—Supposing you were selling it as you say to a foundry plant who were using hot metal for castings, what would be the name of the material? A.—It would be called liquid pig.

Q.—Liquid pig what? A.—Liquid pig iron.

Q.—Are there pigs of any other metal besides iron? A.—Pig lead and pigs of copper; a great many different metals are run into moulds and called pigs.

Q.—So that the name "pig" is not used exclusively in connection with iron? A.—No, it is not.

CROSS-EXAMINED BY MR. AYLESWORTH:—

Q.—This Company, the Dominion Iron and Steel Company, had been in practical operation before for some months you came, I understand? A.—Yes the blast furnaces were in operation.

Q.—They had not begun to make the steel commercially yet? A.—They had not at that time.

Q.—At the time you came? A—No.

Q.—But the blast furnaces had been in operation in sending out pig iron for some six months? A.—Yes, about six months.

Q.—And during the whole of that time had been manufacturing the ordinary cold pig of commerce I suppose? A.—Machine and sand pigs but not the regular sand pigs.

Q.—All cold of course? A.—Oh, yes.

Q.—Selling it or storing it? A.—Selling it. They carried some stock, but it was on the market.

Q.—But selling it in the open market? A.—Yes.

Q.—Of course pig-iron is a perfectly well-known commercial commodity having a market price? A.—Yes.

Q.—Sold by the ton, is it? A.—Yes.

Q.—And I suppose graded, is it not? A.—How do you mean?

Q.—Are there not different qualities or grades? A.—Yes. It is sold according to the fracture and also according to the analysis.

Q.—These words "fracture" and "analysis" that you mention are two separate means by which the grade or quality of the iron can be determined? A.—Yes, two separate means for determining the quality.

Q.—And different qualities I suppose command different prices in the market according to the quality? A.—Yes.

Q.—Then after you came, and the manufacture of steel was gone on with by the plaintiff company, did they continue to dispose of any of their other products besides steel? A.—Selling pig-iron right along.

Q.—And are still? A.—Yes.

Q.—But you are not selling any of the pig-iron in the liquid form? You use all the liquid? A.—Yes.

Q.—And are you aware of any case in which there is sale of the liquid material? A.—No, I do not know of any place where they are selling liquid pig.

Q.—The only places where they use it are places where the same company or proprietor owns both the blast furnaces and the steel plant? A.—On this Continent that is true. I do not know anything about the condition elsewhere.

Q.—Then, if I understand you aright, the first thing you have to do to handle iron ore and get it into a merchantable condition, or workable condition, is to get rid of a quantity of the accompanying impurities that are always found present with the ore? Is that general statement correct as to the office of the blast furnace? A.—Well, the office of the blast furnace is to produce a crude form of metal to be used later on.

Q.—In some more perfect matter? A.—In some further process.

Q.—It is the first step in the process of the manufacture of the completed article, whatever it may be, from the ore? A.—Yes.

Q.—You never find iron pure in nature? A.—In very small quantities up in some northern latitude. Enough has been found so that it can be actually said to exist. Only in very small quantities however.

Q.—Practically it is always mixed? A.—It is always in the oxidized condition. Practically as an iron rust. The ore oxide is practically the same composition.

Q.—And I suppose each bed of ore or mine will differ largely from other mines in the constituents of the ore? A.—Practically it does, but not always.

Q —And the same mine will present variations in the chemical analysis of bodies of its ore? A.—Quite often it does. Quite often we get a practically uniform body of ore, but it is not a rule.

Q.—Ordinarily found mingled with what other material? What other elements or metals? A.—Well, for the most part it is found mixed with silica, which is an oxide of the metal silicon, and alumina, which is an oxide of metal aluminum, and lime, which is an oxide of the metal calcium. Lime does not usually occur in the oxide form in the ore. It is usually in a carbonate, and then it is called lime-stone, and magnesia, which is an oxide of the metal magnesium.

Q.—And what about manganese? A—That is a metal and not called an impurity.

Q.—But does it occur with iron? A.—It does usually.

Q —But in the state of nature, or as you find the ore, do you find carbon mingled with the ore? A.—Very seldom except in some special varieties of ore called black sand.

Q.—But generally speaking you do not find carbon with it. A.—No

Q.—The sulphur and phosphorus are enemies? You want to get rid of them? A.—Yes, we have to get rid of these.

Q.—Do they occur with the iron in the ore, or are they introduced in the process of manufacrure? A.—They occur with the iron, and they are intrdouced to some extent in the manufacture, and particularly sulphur. Phosphorus not so much.

Q.—And you generally find the ore mingled with earth I suppose? A.—Yes, generally find it in rather an impure condition.

Q.—Where do you get your ore from? A.—We are getting practically all our ore from Newfoundland.

Q —And it is in the form of hematite? A.—It is in the form of hematite and it occurs in a bed there. Practically one or two long beds or stratas on Bell Island in Conception Bay, Newfoundland.

To be continued.

NEW COMPANIES.

ONTARIO.

Cassiar Coal Development Co., Ltd.—Incorporated 25th Oct., 1902. Capital $300,000, in shares of $100.00 each. Head office: Toronto, Ont.

London-Elgin Oil Co., Ltd.—Incorporated 29th Oct., 1902. Authorised capital $250,000, in shares of $25.00 each. Head office: London, Ont.

Little Rock Consolidated Mining and Development Co., Ltd.—Incorporated 30th Sept., 1902. Authorised capital $2,000,000, in shares of $1.00 each. Head office: Toronto.

Great Northwest Mining Co., Ltd.—Incorporated 29th Oct., 1902. Authorised capital $3,000,000, in shares of $1.00 each. Head office: Toronto, Ont.

New York and Canadian Copper Co.—Incorporated 12th Nov., 1902. Authorised capital $1,000,000, in shares of $10.00 each. Head office: Kingston, Ont.

Indian Joe Gold Mining Co., Ltd.—Incorporated 19th Nov., 1902. Authorised capital $500,000, in shares of $100.00 each. Head office: Toronto, Ont.

The Home Gold and Copper Co., Ltd.—Incorporated 15th October, 1902. Authorised capital $3,000,000, divided into 3,000,000 shares of $1.00 each. Head office: Toronto, Ont.

The Keenora Mining Co., Ltd.—Incorporated 15th October, 1902. Authorised capital $1,000,000, in shares of $1.00 each. Head office: Toronto, Ont.

The Jubilee Mining Co. Ltd.—Incorporated 15th Oct., 1902. Authorised capital $500,000, in shares of $1.00 each. Head office: Toronto, Ont.

BRITISH COLUMBIA.

Halifax Mines of B.C, Ltd.—Incorporated 24th Oct. 1902. Authorised capital $150,000, in shares of 10 cents each.

Rosella Hydraulic Mining and Dev. Co., Ltd.—Incorporated 31st Oct., 1902. Authorised capital $250,000, in shares of 25 cents each.

COMPANY NOTES.

New England-Canadian Asbestos Co.—This company was incorporated in the State of Maine on 5th ultimo with an authorized capital of $1,500,000 in shares of a par value of $1.00. Shares issued $1,200,000. Directors: C. B. Ingraham, F. L. Smith, R. H. Martin, M. A. Steele, B. F. Riddell, Jas. H. Waring, W. L. Wilds, T. E. Hathaway, G. Frank Allen, George Macomber, I. N. McClure. The head office of this company is room 1001, Banigan Building, Providence, R. I. Canadian office, Thetford Mines. The company has acquired 120 acres of asbestos property at Black lake, 200 acres at Thetford and 1800 acres at Broughton, Province of Quebec.

New Goldfields of British Columbia.—The 5th annual report of this company, for the year ended 30th June, 1902, has been issued.

The Profit and Loss Account shows a gross profit of £2,241 5s 4d., expenditure £2,233 16s. 10d., leaving a net profit for the year of £7 8s. 6d. This balance, together with the amount brought forward from last account—viz., £2,240 18s. 3d., gives a total credit balance of £2,248 6s. 9d., from which has been deducted £549 5s. 3d for Income Tax, leaving a net credit balance at date of £1,699 1s. 6d., which with the reserve of £5,000 shown in last year's balance sheet, amounts to £6,699 1s. 6d.

The period covered by this report has not been favorable for this company's operations, which the directors have limited as much as possible, whilst maintaining where necessary its interest in subsidiary undertakings. The working expenses of the company and the payments to directors have meanwhile been considerably reduced.

Velvet Rossland Mine, Limited—The accompanying circular, just issued by that company, will show the greatly improved prospects of this mine, in which the company holds a large interest, and it will be seen from same that the manager, Mr. William Gray, is of opinion that the Velvet Mine at present looks better than ever it did.

The shipments, although as yet comparitively small, have been of high value, and have realized an average of £4 6s. 6d. per ton net from the smelters, and since the 1st September last have returned sufficient to meet all expenses at the mine.

Portland (Rossland) Mine, Limited.—Mr. Gray confirms the reports of Mr. James Morrish and Mr. Sorensen as to the rich character of the ore deposits on this property. The recent satisfactory developments at the Velvet, adjacent thereto, have further tendered to strengthen the favorable opinion hitherto entertained as to its value

Bluebell (Rossland) Mine, Limited.—Was formed to acquire the Bluebell property. This company's interest in it is now, therefore, represented by shares in that undertaking. The property has since been Crown granted, and it will be remembered adjoins the Portland and Velvet Mines.

Maldon Goldfields, Limited.—This company, with the additional capital raised, is carrying out the scheme of deeper working recommended by the

local directors, and at 1,100 feet a mineralised reef was struck, as anticipated, which is now being driven upon.

Klondyke Corporation, Limited.—There is practically no change in the position of affairs of this company since last report.

Melkedalen Copper Mines, Ltd.—The position of this enterprise is fully set out in a circular just issued to the shareholders of that company. Mr. Harman and Mr. Brooke Mee visited the property in September last, with Mr. Rickard, the consulting engineer, and feel assured that this company's interest in that undertaking is of great prospective value.

Le Roi.—Cabled returns for November: "Shipped from mine to Northport during the past month 15,576 tons, containing 8,380 oz. of gold, 9,600 oz. of silver, 407,400 lb. of copper; estimated profit on this ore, $75,000. Shipments from second-class dump suspended for the winter months."

Giant.—Cable received 5th December:—"Output for month of November, 215 tons. Return from smelting works $12 net per ton."

Montreal & Boston —Officials of the Montreal & Boston Copper Company have received information of the discovery of an important body of ore in the Crown silver mine, belonging to that company. The ore was found at the 150-foot level, and thus far shows a value of more than $11 per ton or nearly double the average value of the ore hitherto taken from the mine. The management will at once increase the daily output to about 200 tons. This the company will be able to handle when its new furnace is completed, which will be on or about Feb. 1.

CENTRE STAR.

The following is excerpted from Mr. Kirby's annual report referred to editorially in this issue of THE REVIEW:—

The condition of the Centre Star mine has much improved during the past year. The reserves of pay ore have been increased. The heavy decline in the price of copper has been more than offset by the reduction in smelting rates and the satisfactory solution of the problem of treating the low grades by milling now makes it certain that the large bodies of this ore exposed throughout the mine will soon be available.

There is no change to report above the 4th level.

The 5th level has developed within the main ore shoot two ore bodies which are now evidently continuous through the block of the 4th level second and third ore bodies described in the last report. Of these 5th level ore bodies, one is found to have large dimensions, extending 125 feet along the vein, averaging 29 feet in width and $8.25 smelter's gross assay value. The other is 75 feet long, 9 feet wide, averaging $16.00 smelter's gross assay value. These bodies extending below, terminate at some point in the block between 5th and 6th levels.

At the 6th level, the vein was found to branch. The north branch followed the previous place of the vein in which the inclined shaft is located, while the south branch assumed a more vertical position, departing at the shaft so that at the 8th level it stands about 200 feet south of the shaft station. The north branch so far as tested on the 6th, 7th and 8th levels is poorly mineralized and without pay values. The heavy mineralization is found to have followed the south branch, which is evidently the main vein. Its junction with the north branch has been found on the 6th level to lie about 450 feet east of the shaft. The time required to reach the vein in its new position by cross cutting back of the shaft stations has much delayed the exploration on the 7th, 8th and 9th levels. It is now well exposed on the 6th level, which extends through the greater part of the length of the claim The south vein is but partially opened by the 7th level, while the 8th level has only just begun, and the 9th level cross-cut has not yet reached the vein. On account of this delay, it was deemed best to suspend shaft-sinking until the three lower levels were more advanced.

The 6th level pay ore, so far as now known, comprises the aforesaid downward extensions into its block of the two-fifth level bodies. There is also a body 355 feet east of the shaft, which as cut by the level is 50 feet long and the full width of the level, averaging $7.95 per ton. With this exception, the level is generally in low grade ore and at various places in its course east of the shaft it cuts bodies of milling ore. These are evidently large in quantity, although their precise limits and grade cannot be ascertained until they are opened out for stoping.

The 7th level has so far exposed no pay ore, but has cut a body of milling ore of unknown dimensions.

The few feet of drifting done on the 8th level has been in low grade ore, but at the date of writing (Nov. 12) the level west from the shaft cross-cut has passed through 25 feet of high grade ore, averaging $16.00 smelter's gross assay value. The heading is now in low grade ore.

The ore sales during the year are 11,087 tons, averaging $13.31 smelter's gross assay value. The average assay contents were: Gold, .64 oz.; silver, .56 oz.; copper, 1.2 per cent. The present reserves of ore payable under the new smelter's rates are estimated at about 100,000 tons, averaging $10 33 smelter's gross assay value (priceing copper at 12 cents, instead of 16.25 cents as in former reports). These reserves include only ore so exposed that its limits and grade can be estimated with reasonable certainty. They do not include the downward extension of the 5th level ore bodies into the 6th level block, nor do they include the better portions of milling ore bodies which in a number of places are known to carry enough value to make them payable under the new smelter's rates.

The development of the mine has from the beginning continued to expose large quantities of ore too low in grade for smelting, but rich enough to promise a handsome profit to successful milling. Now that the difficulties of such treatment has been overcome, these low grade masses will soon be available. It is impossible to present any reliable estimate of their quantity or precise value, because their limits have not been clearly defined, and, until milling begins, they cannot be accurately sampled without excessive expense. The process of stoping them for the mill will undoubtedly develop much ore of higher grade which is not now disclosed by the workings.

CON. LAKE SUPERIOR.

The following is extracted from the first annual report covering the year ended 30th June last:—

IRON AND STEEL OPERATIONS.

Within the past year the operations of your Company have been very largely increased by the starting of the Bessemer steel works and rail mill of the Algoma Steel Company, Limited. The entire mechanical equipment of this plant was installed and practically ready to run at the end of 1901, but owing to delay on the part of the contractors for the structural work and the lack of girders and columns to support the cranes, without which the mill could not be operated, it was impossible to put this plant into operation before the close of the fiscal year, since which time it has been running continuously. The starting of this mill was an event of no little importance in the history of Canada, as it marked the beginning of a new industry of great magnitude and the rolling of the first rail in the Dominion from Canadian Bessemer steel, made from Canadian pig iron smelted from Ontario iron ore.

The steel produced thus far in the Algoma works has been made from purchased pig iron, of which a large supply was acquired in advance of the starting of the plant at advantageous prices, as the blast furnaces of the company have not yet been completed. Two furnaces, one to use charcoal and the other coke, are under construction and are now well advanced towards completion, to be followed by additional furnaces as may be required. Like everything else dependent upon iron and steel manufacturers for material, the construction of these furnaces has been greatly delayed. The completion of the blast furnaces will give to the Company its own supply of pig iron which can be produced profitably at a much lower price than it can be purchased, and which, furthermore, will enable the Company to earn the bounty which the Canadian Government pays on pig iron made from ore mined within the Dominion, only the bounty on steel now being earned.

The Bessemer steel works and rail mill now in operation constitute a thoroughly modern and well-equipped plant. Its converting capacity is sufficient to produce 600 tons of Bessemer steel ingots daily, while the blooming mill and rail mill will finish from 1,000 to 1,200 tons per day. The arrangement of the plant is such that material can be handled at a minimum labor cost, and an unusually large output per man is thus obtainable. The availability of electric power at much lower cost than steam is one of the great advantages enjoyed by this plant. With the exception of the two main engines, which drive the blooming mill and the rail train, and the blowing engines of the Bessemer steel department, electric power is used throughout the works for the operation of cranes, live rolls, tables, saws, drills and straightening presses.

There are few plants so well arranged and so efficiently equipped and with the completion of the blast furnaces, which will furnish an independent supply of pig iron, it is believed that these works will be in a position to compete successfully with the best equipped mills in the manufacture of steel rails.

Renewals on the 18,000 miles of railroad now existing in Canada, and the requirements of the new construction which is bound to increase largely under the progressive policy of the Dominion and Provincial Governments, will furnish a sure market in Canada for steel rails far in excess of the capacity of this first mill, as indicated by the orders which your Company already has booked.

(*Iron Ore Mines.*)—The iron ore operations of your Company are probably the most important productive undertakings, not alone on account of the profits on the mining and sale of ore, but also because of the profitable business which the transportation of this material furnishes to your railroad and steamship lines, and beyond this the completion of the blast furnaces will make these mines the independent basis of the steel industry at Sault Ste. Marie.

Iron ore shipments thus far have been confined to the Helen mine which has fully justified all expectations as to the extent of the deposit and the quality of the ore. The shipments during the fiscal year of your Company ended 30th June, 1902, amounted to 341,750 tons as compared with 91,436 tons during the preceding year.

Since the beginning of the present season, work at the Helen mine has been devoted largely to the systematic development of the property in such manner as to permit continuous shipments much larger than have been possible since the first opening of the mine. Shafts have been sunk, and at different levels workings are being extended in a solid body of ore, which will permit the mining of ore of higher grade even than was indicated at the surface. The first ore is now being raised from underground, and an increase in the output is now made possible.

Lake Boyer, on the shore of which the Helen mine is located, has been drained, and a large body of surface ore has thus been uncovered. An extensive deposit adjoining the Helen mine which was not included in the property originally purchased, has been acquired by your Company, and this will permit the extension of operations at the Helen mine to greater advantage. The purchase of this adjacent property, with other mining claims held by the same owners, now gives your Company complete control of the Michipicoten iron range, and provides not only opportunity for present mining operations, but also abundant reserves for the future. Your Company will be in a position to meet the demand for iron ore for a term of years extending so far into the future that the time of its termination need not be considered.

The extension of the railroad to the Josephine mine, ten miles beyond the Helen mine, now affords an outlet to the second of your iron ore properties that is under development. At the Josephine mine a shaft has been sunk and the development of the deposit is being carried on, so that the shipments once begun can be continued without interruption. The beginning of another season will see this mine ready to make shipments of high-grade Bessemer ore.

Several other iron ore properties have been located along the surveyed line of the Algoma Central and Hudson Bay Railway, and as railroad construction proceeds their development will be undertaken.

(*Charcoal and By-products*)—The abundant supplies of hardwood upon the Ontario land grants of your Company will furnish ample fuel resources for many years. To meet the requirements of the charcoal blast furnace, and for other purposes, by-products retorts and bee-hive kilns have been constructed, with sufficient capacity to give a surplus of charcoal for sale after providing amply for all requirements of your Company's various plants, recent developments having opened markets elsewhere which will permit the sale of large quantities of charcoal at profitable prices, so that this department of operations can readily be made a source of considerable additional income.

Adjacent to the blast furnaces and steel works at Sault Ste. Marie a battery of twenty by-product retorts has been constructed, with all the necessary equipment for recovering the products of distillation and preparing them for sale. Experience has fully established the practical economy of making both coke and charcoal in ovens, which will prevent the loss of the by-products, and in the operation of the charcoal retorts which have been constructed at Sault Ste. Marie the recovery of the waste products—acetate of lime and wood alcohol—will practically pay the cost of making the charcoal. There is a ready market for the by-products and advantageous offers for the purchase of the entire output have been already made.

In addition to this by-product plant, fifty-six bee hive kilns have been built at points on the Algoma Central & Hudson Bay Railway, where supplies of hardwood can be obtained to the best advantage.

(*Nickel Operations.*)—Development of the nickel properties of your company in the Sudbury region of Ontario has proceeded continuously during the past year, and excellent progress has been made in bringing these properties into productive condition. Mining has been carried on steadily at both the Gertrude and Elsie mines, and in addition to the raising of a large amount of ores, these mines have been developed so that the desired output can be maintained continuously. Further exploration of these properties confirms the first impressions as to their extent and value, and it is now beyond us that in these mines your company possesses some of the most important deposits of nickel ore in the world.

The pure nickel ore, that is the ore which contains nickel without copper, is shipped from your mines to Sault Ste. Marie, Ont., where it is crushed and roasted to remove the sulphur. The sulphurous fumes from the roasting furnaces are utilised in the sulphite pulp mill, thus saving the usual expense of sulphur or pyrites required in chemical wood pulp mills. The roasted ore is pressed into briquettes, in which form it is ready for smelting with iron ore in the blast furnace, the resultant pig-iron containing a sufficient percentage of nickel to make a high grade of nickel steel when this iron is converted into steel Pending the completion of the blast furnaces a large stock of the briquettes of roasted nickel ore is being accumulated ready for smelting when the furnaces go into operation. The making of a ferro nickel pig and its subsequent conversion into nickel steel will complete the series of processes for which the group of works at Sault Ste. Marie was designed and will permit the production of nickel steel with economy and positive results. The early completion of the blast furnaces, which is being hastened with all possible urgency, is all that is now required to put this plan into full operation.

The ore from the nickel mines containing copper are roasted in heaps at the mines to remove the sulphur, and the cinder is ready then for processes of reduction to metallic nickel and copper. The first smelter at the Gertrude mine was put into operation in June, with a daily capacity of about 20 tons of matte, containing about 16 per cent. of nickel and 8 per cent. of copper, and two additional smelters of similar capacity are under construction and approaching completion. A Bessemerizing plant for the elimination of the iron and impurities and the concentration of the 24 per cent. matte to about 80 per cent. of metallic contents will complete the works and enable the production of high grade matte of the preferred marketable form.

Contracts have been made with consumers of this matte, who will take a quantity equal to the entire output of the plant now provided for, and who will erect large works on the company's property on the American side at Sault Ste. Marie, for the refining and further manufacture of this material, using power from the new canal.

Negotiations have just been concluded for the establishment of large electrolytic refining works at Sault Ste. Marie, Ont., which will require an additional supply of ore from the nickel mines and matte from the smelters to be reduced into metallic nickel and copper

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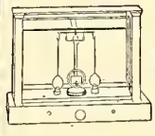
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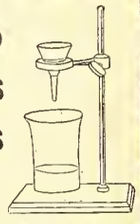
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Montreal, 21st February, 1902.

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The undersigned offers for sale Mining Location W.D. 43 in the Township of Rathbun. A large amount of development has been done upon this property. A ten-stamp mill has been erected, with five stamps working. Bullion to the value of $7,500 has been produced, on an average of $12.00 per ton. The ore is free milling. Tenders for above property will be received by the undersigned, from whom full particulars can be obtained.

WM. R. WHITE,
Liquidator of The Crystal Gold Mining Co. of Rathbun, Limited.

Dated PEMBROKE, June 26th, 1902.

TWELFTH EDITION

The Canadian Mining Manual

FOR 1902

Up to date particulars of the Organisation, Equipment, Operations, Output, Balance Sheets and Dividends of all Canadian

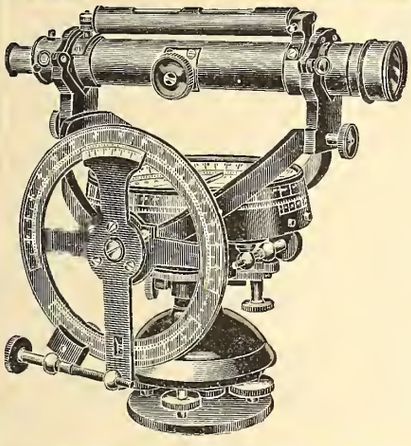
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For further information see the Calendar of Queen's University.

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For Calendar of the School and further information, apply to

The Secretary, School of Mining, Kingston, Ont.

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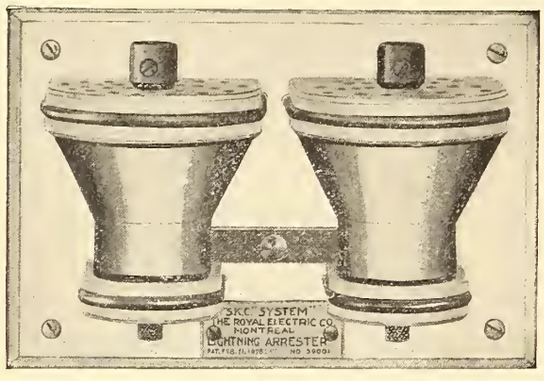
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GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents anuually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. A. DRYSDALE,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

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The attention of Miners and Capitalists in the United States and in Europe is invited to the

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ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes:—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals*; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phospbate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms:—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction or 100; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds: Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less, but not for more; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in-Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties, unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at th mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,
PARLIAMENT BUILDINGS, QUEBEC, P. Q.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order-in-Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end of the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 per acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee, $5.00, renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings, but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed or bars in the rivers below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River, and Hill claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim must hold a Free Miner's certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of 2½ per cent. on the value of the gold shipped from the Territory to be paid to the Comptroller.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek, or gulch, but the same miner may hold any number of claims by purchase, and Free Miners may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch, or river, by giving notice, and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00, and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette*.

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, at the rate of 2½ per cent. on the value of the gold shipped from the Territory. Operations must be commenced within one year from the date of the lease, and not less than $5,000.00 must be expended annually. The lease excludes all base metals, quartz, and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery, at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council

JAMES A. SMART,
Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

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In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc, apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

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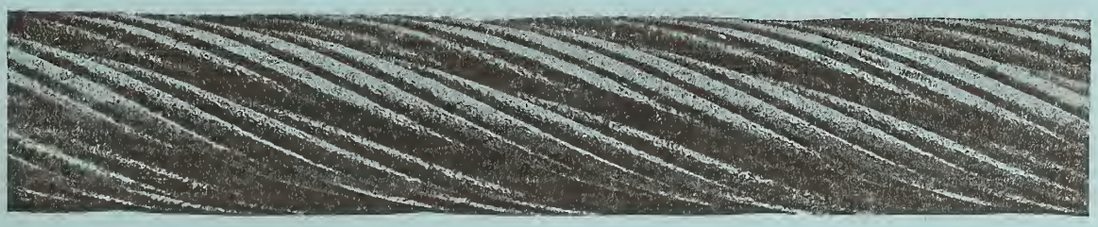
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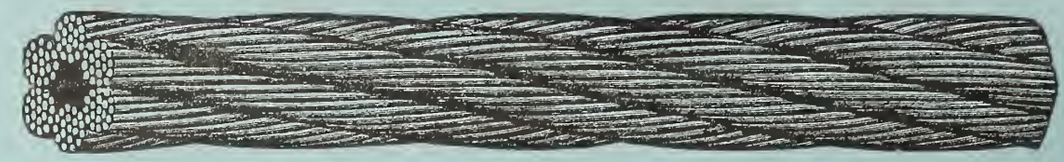
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